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9 JUNE 1939
INSTITUTE

BERMUDA

REPORT

of the

DEPARTMENT

of

AGRICULTURE

for the year

1938

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Board of Agriculture, 1938.

From 1st January to 27th June.

Mr. A. J. Gorham, Chairman.
Wor. B. C. C. Outerbridge, J.P., M.C.P., Deputy-Chairman.
Mr. E. J. Moniz
Mr. W. S. Cooper, M.C.P.
Mr. J. H. Hollis
Mr. H. T. North, M.C.P.
Mr. J. E. P. Vesey, M.C.P.
Mr. H. Dunkley, M.C.P

From 28th June to 31st December.

Wor. B. C. C. Outerbridge, J.P., M.C.P., Chairman.
Mr. J. E. P. Vesey, M.C.P., Deputy-Chairman.
Mr. A. J. Gorham
Mr. J. H. Hollis
Mr. H. T. North, M.C.P.
Wor. S. S. Toddings, M.C.P.
Mr. A. C. Benevides
Mr. H. Scott
Mr. W. M. Conyers.

Department of Agriculture, 1938.

Director of Agriculture, T. A. Russell, B.Sc., A.R.C.S., A.I.C.T.A., Dip. Agr. (Cantab).
Plant Pathologist, J. M. Waterston, B.Sc. (Edin.) A.I.C.T.A.
Agricultural Assistant, W. R. Evans.
Horticulturist, G. R. Groves.
Inspector of Produce, T. Arthur Hollis.
Clerk, Nora E. Hollis.

PART-TIME OFFICERS.

Government Veterinary Officer, C. J. Cooper, V.S.
Assistant Inspector of Produce, C. V. S. Early.
Sub-Inspectors of Produce, A. W. B. Fowle, T. J. Outerbridge.

LETTER OF TRANSMISSAL.

Agricultural Station,
Paget East, Bermuda
6th April, 1939.

Sir,

I am directed by the Board of Agriculture to lay before His Excellency the Governor, for the information of the Legislature, the accompanying reports of the Department of Agriculture for the year ended 31st December, 1938.

I have the honour to be,

Sir,

Your obedient servant,

NORA E. HOLLIS,
Clerk, Board of Agriculture.

The Honourable,
The Colonial Secretary,
Hamilton.

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Report of Director of Agriculture, 1938.

The Chairman,
Board of Agriculture.

I have the honour to submit reports of the Department of Agriculture for the year 1938.

I. AGRICULTURE IN 1938.

The year was on the whole a most difficult and depressing one for the agricultural industry in Bermuda. In the first place the weather was perverse and undependable. Although the total rainfall for the year recorded at the Agricultural Station was 59.88 inches, or a very little above the average for the past five years, its distribution was most exceptional, one half of this amount falling in the last four months and just over one fifth in the first four months. As a result the crops suffered from drought in the spring and from excess of rain in the autumn. The unbalanced distribution is shown clearly in the Records of Rainfall which are included in Appendix A. Fortunately the weather was also exceptional in providing few storms of wind, the only wind which caused serious damage to crops occurring in the third week of December.

Secondly, pests and diseases caused heavy loss to the farmer in the case of some of the crops. An extraordinary plague of caterpillars of various types, known locally as fireworms and cutworms, occurred during the latter part of the year, and, where proper precautions were not taken, fields of potatoes and of other crops were eaten up in an incredibly short time.

Thirdly, as regards the export market in North America the season was as disappointing as any of its predecessors, and indeed the volume and value of the farm-produce exported reached a new low record. For this sad condition the severe trade depression may to some extent be blamed, since it undoubtedly played a part in reducing the demand and prices in the vegetable market. But it must be admitted that the decline in 1938 merely continued the major decline which has been a feature of the last ten years.

In the existing circumstances, which include scarce and expensive labour and high cost of production, Bermuda cannot hope to compete in a low-priced market but can only afford to sell a specialty or an article of high quality which can command a premium. As an example of a specialty which was formerly very successful, the Bermuda lily may be cited. Unfortunately in recent years this lily has been superseded for some purposes by lilies from other sources. In the case of vegetables the produce from Bermuda does not appear to have been arriving in the highly competitive overseas markets in sufficiently good quality to command top prices, and instead it has fetched the low prices of the second-rate. This is attributable firstly, to faulty methods of growing, and secondly, to improper methods of harvesting and shipping.

Produce of the first quality can only be expected from land which is in good heart and which is farmed efficiently. Many farms are not producing first-class vegetables either because the farmer is poor financially, because he cannot afford to give the land manure or the cultivation it requires, or else because he is lacking in the knowledge of how to produce better stuff. As was pointed out in a previous Report the lack of sound financing is perhaps the greatest weakness of the industry.

In other cases, granted favourable weather, the quality of the vegetable at the time of reaping is excellent, but the difficulty then arises of preserving its excellent condition till it is placed on the market since no efficient system exists for handling perishable produce before shipment from Bermuda. Whether it be in Canada or in New York, the produce of Bermuda has to meet competition from produce of California or Florida or Texas grown with modern efficiency and placed on the market in all the freshness and good quality which the most up-to-date precooling and cold-storage can ensure. Against such competition the produce of Bermuda, reaped in haphazard fashion and stacked on the dock for a day or more before shipment, has little chance. For a trade in perishable vegetables, whether it be in celery to New York or in carrots or tomatoes to Canada, facilities for efficient precooling and cold-storage are now essential. During the year, further consideration was given to the plans for a pre-cooling plant on the docks, in which perishable produce for export might be collected and stored so as to be transferable to the ship's chillroom without re-heating, but for various reasons no material progress was made.

Alterations in the Customs Tariffs of the United States and Canada made in recent years have had profound effects on agriculture in Bermuda, and accordingly it is of interest to note the changes in agricultural tariffs which will follow the recent Trade Agreements made by the United States with the United Kingdom and with Canada. While Bermuda loses some of the protection for her vegetables enjoyed in the Canadian market for the past five years, she should derive benefit from lowered customs duties on some of her produce entering the United States.

Disappointed in the returns from foreign markets, growers have given increased attention to the local market. Fortunately, the Colony experienced an excellent tourist season and the local demand for farm produce was probably as great as it has ever been. Any true estimate of the volume or of the value of produce consumed in the local market is very difficult to make since produce reaches the kitchen from the field in so many different ways. Increased use was made of cold storage for holding supplies of vegetables into the summer, and a large volume of potatoes

was stored in this way and also quantities of carrots and celery. The lack of demand for potatoes abroad left growers with large supplies of potatoes in their barns at the beginning of summer. In order to ease the situation an Act of legislature was passed, empowering the Governor-in-Council to prohibit the importation of potatoes over a stated period under penalty of a levy additional to the ordinary Customs duty, and this added protection went into force for a period of five weeks from 18th August.

In the depressing conditions which surround the industry, it is easy and rather popular at the present time to suggest that Agriculture has no future in Bermuda and might as well be left to its fate. This is to lose sight of the greatest problem which faces the Colony, the problem of her pressure of population which, already great, yet increases yearly. In the face of this problem, to abandon any industry is unwise, and to neglect the future possibilities of the agricultural industry is folly. Because the investment is at present returning a poor dividend, it is not necessarily without prospects for the future.

The second section of this Report, headed "Work of the Department" outlines the main ways in which assistance is being given by the Government to the industry. In general they consist of an active programme of investigation which aims at solving some of the difficulties troubling the industry, and a greater use of extension work to instruct in improved agricultural methods. This is the soundest type of help which can be given, but it may be noted that in other countries, whether it be by New Deals or by wheat subsidies, Governments have found it necessary to go further than this to help the struggling industry. In Bermuda also it may become necessary for the Government to step in and assist the reorganisation of Agriculture.

The Export Markets. The quantities of vegetables and lily bulbs exported to various countries during the shipping season of 1938 are summarised in the following table. In the case of potatoes exported to the United States of America the figures refer to the shipping-season which started at the end of November 1937 and continued till April 1938.

Commodity.	U.K.	Canada.	Br. Guiana & B.W.I.	U.S.A.	Other Countries.	Total.
Beets (bushels)	—	842	—	—	—	842
Cabbage "	—	2,666	1,428	—	—	4,094
Carrots "	—	18,983	177	30	—	19,190
Celery "	—	19,910	—	—	—	19,910
Cucumbers "	—	9	—	—	—	9
Kale "	—	—	—	183	—	183
Onions "	—	286	10	—	—	296
Parsley "	—	63	—	—	—	63
Potatoes "	1,720	3,623	602	6,759	—	12,704
Spinach "	—	105	—	—	—	105
Tomatoes "	—	7,354	8	—	—	7,362
Miscellaneous	—	34	28	—	—	62
Total (bushels)	1,720	53,875	2,253	6,972	—	64,820
Lily bulbs (cases)	328	121	2	1,442	56	1,949

The total volume of vegetable exports at 64,820 bushels compares with 71,959 bushels in 1937 and is the smallest volume exported from Bermuda in any year since records were kept. It represents 33% of the average quantity of vegetables exported in the previous ten years.

The estimated returns to Bermuda from the sale of agricultural produce (excluding cut-flowers) in various countries, arrived at by subtracting freight-charges and selling-costs from the gross receipts, are shown in the following table. Accurate returns for the sale of cut-flowers are not available, but they are believed to have approximated to £5,400, mostly from sales in the United States.

Country of Export.	Estimated Value of Return.		
	1936.	1937.	1938.
Canada	£17,100	£13,800	£12,000
United States of America	11,400	8,900	5,700
United Kingdom	1,000	1,100	1,300
British West Indies & Br. Guiana	200	400	500
Other Countries	100	100	100
	£29,800	£24,300	£19,600

The Canadian Market. As usually happens the volume of produce grown for shipment to Canada was based on the results obtained in the previous year. Thus the acreage of celery, a vegetable which fetched rather poor prices in 1937, was reduced in 1938, while the acreage sown with carrots, a crop which sold at exceptionally high prices in 1937, was greatly increased. The volume of vegetables shipped to Canada in 1938 amounted to 53,875 bushels as against 54,647 bushels in 1937 and 97,628 bushels in 1936.

Unfortunately the general level of selling-prices was extremely low so that the value of the exports to Canada, at £12,000, was less than in any year since regular shipments were made to this market.

In the following table the average price per crate at which each major commodity was sold is compared with corresponding prices in the four preceding seasons.

Commodity.	1934.	1935.	1936.	1937.	1938.
Beets, per crate	$1.31	$1.72	$1.43	$1.84	$1.40
Cabbage " "	1.92	2.33	1.49	1.85	1.67
Carrots " "	1.40	1.54	1.24	2.24	1.43
Celery " "	2.40	2.33	2.07	1.82	1.95
Onions " "	1.31	2.06	0.73	1.49	2.06
Potatoes " "	1.62	1.47	2.30	2.09	1.68
Tomatoes " "	1.90	1.60	1.16	1.32	1.00

If the cost of crate and charges for packing, ocean-freight, any land-freight, and brokers' commission are subtracted, it is possible to obtain some idea of the return to the farmer for produce selling at the prices quoted above in the column for 1938.

Commodity.	Calculated Return to Farmer 1938.
Beets, per crate	3/2
Cabbage, " "	2/-
Carrots, " "	3/-
Celery, " "	3/6
Onions, " "	6/-
Potatoes, " "	4/5
Tomatoes, " "	2/8

As in previous seasons, produce was shipped only to Messrs. J. Hunter White Ltd., St. John, New Brunswick; Messrs. J. W. Gorham & Co., Halifax, Nova Scotia; and Messrs. Mutual Brokers Montreal Ltd., and Messrs. Marshal and Morrison Ltd., in Montreal. These brokerage firms co-operated closely with the shippers of produce and with the Department and this opportunity is taken of gratefully acknowledging their assistance and efficient service.

The following table indicates the distribution of shipments to the three ports.

Commodity.	Halifax.	St. John.	Montreal.	Total.
Beets, (crates)	287	392	163	842
Cabbage "	183	1,031	119	1,333
Carrots "	6,826	7,266	4,891	18,983
Celery "	997	2,054	6,904	9,955
Onions "	36	224	26	286
Potatoes "	119	3	3,501	3,623
Tomatoes (lugs)	3,064	4,528	14,470	22,062
Miscellaneous	78	120	38	236
Total (Packages)	11,590	15,618	30,112	57,320

About one-third of the celery for Montreal was shipped via New York, advantage being taken of the frequent service by the Furness-Bermuda Line. The rest of the shipments were made direct to Canada by Canadian National Steamships, and acknowledgments are due to the Agents of this line for their co-operation on various occasions.

Other Export Markets. The quantity of vegetables exported to the United States of America in 1938 was by far the smallest quantity in any year of which we have record. Only 6,972 bushels were shipped, consisting of potatoes and of Portuguese kale, as against 14,419 bushels in 1937 and 420,802 bushels in 1928. There was a significant decline in the sale of Easter lily bulbs, but an increase in the number of lily buds and cut stems shipped to the United States.

The shipment of approximately 860 cwts. of new potatoes of Royal Kidney variety made to England under a marketing investigation of the Department of Agriculture is described in a later section of this Report in connection with work of the Department.

Small quantities of cabbage, carrots, onions and potatoes were sold in British Guiana and in some of the British West Indian Islands.

The Domestic Market. The sale of produce locally continued to suffer from excessive competition and from lack of any organised production or marketing. The Farmers' Market enjoys a large retail trade in farm-produce, and, though the complaint is frequently made that the business is in the hands of a select few, this is largely unavoidable on account of the confined space available in the present building. Many farmers have also found it profitable to have a cart on the roads peddling vegetables, and this method of bringing farm-produce to the door has played a part in encouraging its greater use in the home.

Hotel-stewards and others requiring large quantities of produce still complain of difficulty in obtaining continuity of supply of certain vegetables in the local market and accordingly they are apt to depend on imported supplies. One of the chief needs appears to be a wholesale market where merchants and hotel-stewards can buy produce in bulk at wholesale prices.

The Chief Crops: Potatoes. The Bliss Triumph crop dug in January gave a yield which was good from the point of view of quantity, but poor as regards quality. At the Packing-House the proportion of potatoes rejected because of defects was unusually high, amounting in some instances to three barrels out of every ten brought by the grower. The causes were analysed and it was found that cracking or splitting, due to rough handling at the time of digging, was the main cause of loss. Common scab was destructive in some lots but not in others and Phytophthora rot caused damage in some cases. Much of the loss could have been avoided with intelligent care.

The succeeding crop of Chili Garnet and Irish Cobbler potatoes suffered from drought and gave low yields except in low-lying ground. The Cobblers especially suffered very severely from Common Scab so that in some fields it proved hardly possible to find a potato which was entirely clean. A high yield of Royal Kidney potatoes was obtained from pondland by one grower who planted 20 barrels of seed and of the resulting crop sent 192 barrels to the Packing-House for shipment.

The autumn crop of Bliss Triumphs was a comparative failure. All the seed was obtained from Nova Scotia and some lots proved to be infected with virus, counts as high as 18% leafroll and 1% mosaic being seen in the field. Some growers planted the seed too early, so that, although treated with ethylene chlorhydrin to break the period of dormancy, the seed nevertheless failed to make a good stand. Moreover the weather was too wet for successful growth, strong winds before Christmas shortened the life of the crop, and heavy loss was caused by caterpillars. From one cause and another, a very small crop was dug.

Tomatoes. The main crop of tomatoes for export was extremely unfortunate with the weather, for it suffered from drought in the early stages and was nearly washed away by rain when it had reached the age of bearing. As a result a smaller quantity was shipped than for several years, and, as the selling-price in Canada was also low, the crop was most disappointing.

Other Vegetables. The dry spring season appeared to suit celery grown in the pondlands and a crop of excellent quality was reaped, said by some to be as good as any shipped from Bermuda in the past. Septoria

blight, which commonly spoils the crop, did not appear until the greater part had been cut. A large crop of carrots was grown for export but it suffered to some extent from drought as did most of the other vegetables grown during the spring season. The onion crop indeed was a complete failure from this cause.

Easter Lilies *(Lilium longiflorum).* In spite of a further decline in the sale of the bulbs, the growing of the Bermuda Easter Lily continued to fill an important place, particularly in the agriculture of the eastern parishes. More than half the area planted with lilies indeed was to be found in St. David's Island. As usual all fields were inspected by the Plant Pathologist at least twice during the growing season with the object of ensuring that the lilies were satisfactorily free from virus diseases.

The total exports of bulbs amounted to 1,949 cases, as against 2,346 in 1937. The decrease in the sale of bulbs was in part offset by an increase in the quantity of flowers exported, 10,764 packages being shipped as against 7,423 in 1937. From the following table it will be noted that, although the volume of bulbs shipped in 1938 was less than in any of the four previous years, the variation over this period has not been very large.

Year	Exports of Lily Bulbs.
1934	2,309 cases
1935	2,490 "
1936	2,578 "
1937	2,346 "
1938	1,949 "

The reduction in the sale of bulbs was not confined to any one country but occurred simultaneously in the United States, Canada, and Great Britain. The conditions at the time of sale are ably described by Messrs. Robert Tucker & Co. in the following extract from their Report on the Bermuda Lily Bulb Trade in Great Britain in 1938.

"During the past five years it has been necessary, unfortunately, to make several rather depressing reports about the conditions of trade in Great Britain and Europe. As may be remembered, the loss of useful orders, first in Germany, and later in France and Holland, were fully described at the time. Last year, for the first time for many years, sales were perforce confined to the United Kingdom, and it hardly seemed too much to hope that this would mark the limit of the shrinkage in the trade. It is much to be regretted that this hope has not been fulfilled. It is true that the majority of customers for Harrisii bulbs have sent orders; but for reasons which can easily be understood, in a good many cases the quantities were smaller than usual. The all round reduction is about 8 per cent, which can ill be spared while the business is on its present moderate scale.

"It is hardly necessary to say that the main reason for the falling off was the tension and uncertainty of the months immediately preceding the recent European crisis, although some part is probably attributable to the impression left by the heavy dumping of Japanese lily bulbs in 1937, of which further mention will be made later. When it is remembered how closely the development of the crisis coincided with the season for selling and shipping Bermuda lilies, it is some consolation to know that buyers seem to have disposed of their purchases in a satisfactory way, and that at

least there is reason to expect that whenever general conditions improve there will be a corresponding revival in their orders. Disappointing as it is to feel that ground has been lost, the effects are not likely to make the trade permanently shy of Bermuda lilies, as might be the case if any of them made a heavy loss.

"The prices realised this year in a few cases were slightly lower, but not to any great extent. This was due, in the main, to the ridiculous prices realised for Japanese bulbs twelve months ago. When superfluous shipments have to be carried forward unsold from sale to sale, to be finally knocked at prices which literally do no more than cover the freight and the auctioneer's charges, how is it to be expected that trade can help being demoralised? Bermuda lilies, as we have said before, do not exactly come into competition with Japanese Giganteum, nor even very much with Formosum. The Harrisii is rather a speciality. While this is a bad thing in so much as it limits the quantity sold, in present circumstances it is perhaps a benefit. However this may be, although our lowest prices, which are in the region of 40/- per case, may not be as high as is desirable, they are at least vastly better than the 15/- to 20/- realised by the Japanese during December and January last."

While the decline in the export of bulbs may be largely due to political and economic conditions, it remains the case that the market for the Bermuda or Harrisii lily (L. *longiflorum* var. *eximium*) is limited by its qualities, in particular by the delicacy of the blossoms, and by the intolerance of the bulbs to prolonged cold storage. Growers have accordingly been interested in recent years in making trial of other varieties of *Lilium longiflorum* in the hope of finding additional types which could profitably be grown. In this connection reference may be made to the breeding and trial of new varieties which are mentioned in a later section dealing with the experimental work of the Department. A seedling raised some years ago by Mr. H. E. D. Smith of St. David's has shown outstanding qualities and first commercial shipments were made during 1938, 79 cases of this early-flowering type being included in the exports of lily bulbs. A trial consignment sent to England the previous year was grown for exhibition purposes in 1938 and Messrs. Robert Tucker & Co. make the following comment.

"In 1937 a small quantity of Mr. H. E. D. Smith's new variety was sent. On this occasion they were grown by Messrs. James Carter & Co. and shown at the Royal Horticultural Society Hall and at Olympia. The plants were exceptionally good and, as a comparative test at Kew Gardens in the previous year showed that they are decidedly early in flowering, they should be a welcome addition to the Harrisii, especially where forcing facilities are limited".

As in former years the sale of lily bulbs in the United Kingdom was in the capable hands of Messrs. Robert Tucker & Co. whose keen efforts on behalf of the industry are gratefully appreciated. Thanks are due also to Mr. F. H. Burn who once again organised the distribution of lily bulbs as prizes to numerous Horticultural Shows.

Milk. The production of milk remains one of the most important branches of local agriculture, but unfortunately it continues to suffer from lack of any rational system of distribution. Milk is produced in many small dairies, each of which has to make its own arrangements for retail-

ing its supply. As a result one group of houses may be served by several dairies with much replication and waste of effort in delivery. The high cost of milk, attributable in large part to costly distribution, unfortunately limits its use to only a section of the community.

A proposal emanating from the Board of Health, that milk should be assembled in bulk at a central pasteurising plant whence it might be distributed by regular routes, was given consideration by representative dairymen, but it failed to commend itself to them. Towards the end of the year up-to-date plants for pasteurising milk were installed in two individual dairies.

Poultry. The effort started by the Department in October 1937 to stimulate the greater production of poultry and eggs has been effective along several lines. A successful show was held in February under the auspices of the Bermuda Poultry Association aided by the Agricultural Assistant and other members of the Department, and this had the double effect of encouraging poultry-men to take greater pride and interest in their birds, and of drawing the attention of the public to this branch of local agriculture. Subsequently two large American firms manufacturing poultry-feed sent representatives who held meetings and did what they could to stimulate the growing of poultry and the use of feed.

This increased enthusiasm is a necessary thing but, as pointed out in his Report by the Agricultural Assistant, it requires to be controlled and guided. While sufficient has been done to increase the local production of eggs, nothing has yet been done to arrange for their disposal and unless this second step is taken the effort expended on the first step is wasted. The local supply suffers from the two disadvantages of being very seasonal and of coming in small quantities from many small producers. For local eggs to capture the whole market the supply must be steady, either from regulated production or by the use of cold storage, and the small supplies must be collected into larger channels so that buyers will know where they can obtain an ample supply at any time. Measures taken by the Department to assist the marketing of local eggs are described in the later section dealing with the work of the Department.

While there is a small demand for local dressed poultry, most of the supply continues to be imported. It appears that if the requirements of the market were to be more carefully studied a larger share might be produced in the Colony.

Other Animal Products. Most of the meat supply is imported but veal, and smaller quantities of pork and of beef, are produced locally. The production of honey is almost entirely neglected.

II. WORK OF THE DEPARTMENT.

The unhealthy state of Agriculture calls for special effort on the part of the Department and serious consideration has been given to the best directions in which this effort can be applied. It is felt that the chief needs at the present time are firstly, an active programme of research on the soil, on manures and on different varieties of crops, which will provide knowledge as to the most efficient and profitable means of farming, and, secondly, added extension work aiming at conveying this knowledge to farmers. With the decline of exports during the year under review the

inspection and packing of produce required less attention on the part of the Department than in former years, and it was possible to devote a larger share of effort to experimental and educational work. The main activities of the Department are outlined in the following pages.

EXPERIMENTAL WORK: (1) **Soil Survey.** As recorded in the Report for 1937 a survey of soils in different parts of the Islands was made by the Plant Pathologist and assistance in their analysis was kindly offered by Prof. F. Hardy of the Imperial College of Tropical Agriculture. The results of the analysis became available during 1938 and may briefly be summarised.

Soil-samples taken from Somerset, Southampton, Paget, Smith's and St. David's showed a general gradation in texture from the sand of the western to the silty-clay of the eastern parishes. The nutrient status followed a parallel course, the red soil of the eastern parishes having the higher nutrient content. The reaction of all samples was highly alkaline with pH 7.5 to 7.8, and free calcium carbonate present. The content of both organic matter and total nitrogen were found to be high, and the carbon-nitrogen ratio indicated complete humification and little accumulation of fresh vegetable residues. The nutrient-content was considered high in all cases. The general conclusion drawn was that the limiting-factor in crop-production was seldom likely to be found in nutrient-content but rather in the moisture relations of the soil, and that these merited intensive study.

In accordance with these findings special attention is being directed to systems of manuring and methods of cultivation which are calculated to improve the water-holding capacity of the soil, and experimental work along these lines is being planned. This opportunity is taken of gratefully acknowledging the assistance given by the Imperial College of Tropical Agriculture through the kindness of Prof. Hardy.

(2) **Varietal Trials.** Trials were made of different varieties of several vegetables with the object of finding varieties most suited to local needs and conditions. To meet the complaint made by hotel-stewards in Bermuda that the type of lettuce which they require is not obtainable in the local market, several varieties of lettuce were grown at the Agricultural Station and samples were submitted for criticism to one of the hotels. The varieties Imperial and New York were considered suitable, both giving solid heads of crisp leaves.

Small shipments of carrots of variety Danvers Half Long, bunched and packed in ice, were sent to New York and to Montreal. The comments in each case were the same: that the carrots arrived in excellent condition but were of the wrong type for the market which prefers a long thin variety. Seven varieties of carrot suitable for bunching were planted in November in order to compare their growth.

A trial of tomato varieties in the autumn months gave inconclusive results owing to poor set of fruit during the abnormally wet weather. Good protection against wind-damage was obtained in this test by having a row of pigeon-peas (*Cajanus cajan*) planted after every six rows of tomatoes, and the indications were that adequate protection would still have been given if the hedges of pigeon-peas had been spaced wider, as for instance with eight rows of tomatoes between. *Gliricidia maculata*, which was also tried, grew too rank to be satisfactory.

Five varieties of strawberry were grown under observation during the first half of the year. In the dry conditions which prevailed, Bellmar proved a complete failure, the plants making poor growth and bearing hardly any fruit, and Premier, though better, was still unsatisfactory. Blakemore, Southland, and Missionary gave better results and were almost equally good. Blakemore led in size of fruit. Southland produced the most vigorous growth of foliage, the berries being borne under cover of the leaves.

(3) **Work on Irrigation.** In order to test the possibilities of growing vegetables through the summer a small irrigating plant, capable of watering an area of 180 square yards, was set up. The equipment consisted of a pipe, 36 feet long, fitted with jets, and an oscillator which was supplied by the C. W. Skinner Co. of Newfield, New Jersey. The source of water was a tank collecting rain-water from a roof. The test was only a partial success through failure of seed to germinate and later through failure of the water-supply; but even so the results were sufficiently good to justify further trial. A similar equipment was used by Mr. J. W. Cox who had a well as the source of supply and his results also indicated that irrigation has its possibilities.

(4) **Work on Lilies.** Observations were continued on different varieties of *Lilium longiflorum* and on crosses made in previous years between these varieties. The progeny of crosses made in 1936 came into flower, and a few promising hybrids combining the earliness of the Harrisii lily with a firm texture of flower were marked. Unfortunately a number of the new hybrids were lost through occurrence in the plot of mosaic disease against which insufficient precautions had been taken. Further crosses between two varieties were made.

A small sample of bulbs of the variety *takesima* (the "giganteum" of the florist) grown at the Agricultural Station was sent to England for trial and Messrs. Robert Tucker & Co. arranged for the bulbs to be tried by a prominent nurseryman. This is the variety which is imported into the United States, Great Britain, and many other countries in very great quantities from Japan. At first thought it appears out of the question that the grower in Bermuda should be able to enter into profitable competition with the Japanese grower, but investigation has shown that the bulbs, if they can successfully be grown in Bermuda, could be on the market at a season when this variety is hardly to be obtained from other sources, so that direct competition may be avoided. This sample had not flowered under greenhouse conditions at the close of the year, but the nurseryman's observations on their early growth were favourable.

(5) **Research on Pasture.** Analyses of typical pastures, given in the Report for 1937, indicated the general lack of leguminous species, the only vetch at all commonly present being *Medicago lupulina.* Samples of seven species of *Trifolium* were obtained through the kindness of Dr. E. A. Hollowell of the Bureau of Plant Industry, United States Department of Agriculture, and they were sown along with two or three vetches obtained from other sources. The first sowing, made on 31st January in prepared plots and on adjacent turf which had been scythed as closely as possible, was unfortunate in meeting an exceptionally dry spell of weather and was a failure. A second sowing suffered in a similar way but the remainder of the seed sown in a damp corner of the pasture gave better results. The following made good growth and bore numerous flowers: Persian clover, Louisiana White Clover, *Trifolium procumbens, T. dubium,* Korean

Lespedeza, and *Melilotus alba*. Others which grew but produced few or no flowers before the summer were *T. glomeratum*, *T. alexandrinum*, and *T. subterraneum*. Common sainfoin and double sainfoin, *Onobrychis sativa*, failed to germinate properly. All these vetches with the exception of *Melilotus alba* died in the heat and drought of summer, and though a few seedlings were beginning to appear by the end of the year there was no clear evidence of any of these species becoming established.

EXTENSION WORK. Close contact was kept with farmers through frequent visits to farms by members of the Department. A number of growers visited the Agricultural Station either for advice or to bring produce to the Packing-House and in this way were enabled to see something of the experimental work being done. A meeting for farmers was held in Southampton in November to discuss the spraying, harvesting, and marketing of the Triumph potato crop. Subsequently two demonstrations of potato-spraying were given on farms.

With the co-operation of the Department of Education, active measures were started to encourage school-gardening, especially in schools attended by boys who may later work on the land. Early in the year a short course in gardening and nature-study was arranged for school-teachers and was held at the Agricultural Station on five successive Saturday mornings. Lectures and demonstrations on the structure and life of the plant, the nature of the soil, and the fungous and insect enemies of plant-life were given by the Director, Horticulturist and Plant Pathologist and were in each case followed by practical work. For convenience of instruction the class was limited to thirty. Judging by the attendance, which averaged twenty-nine over the five days, and by the interest shown by the teachers, the course was a success.

With the start of the winter term in the schools, contact was made with some of the headmasters to see what assistance could be given towards making school-gardens. In the case of Port Royal School and Whitney Institute, advice was given on the lay-out of gardens, and in the latter case further assistance was given in preparing the land and in supplying vegetable seedlings, flower plants and seeds. The Central School, which usually has a set of vegetable plots, was compelled to abandon them for the present during reconstruction of the playground, but the Paget Glebe School announced their intention of starting a garden. Plants were provided to the Gilbert Institute which already has a garden, and to the Sandys Grammar School, which the Garden Club in the Parish has offered to assist.

MARKETING SERVICE AND INVESTIGATIONS. The Agricultural Assistant was stationed in Canada during the main shipping-season to supervise the marketing of produce on arrival there. Through him the Department was kept informed of developments in the market and was thus enabled to advise growers and shippers as to prospects and prices.

As in the previous year, experimental shipments of new potatoes were sent to Liverpool, growers being guaranteed a minimum price of 6/- per crate in order to obtain their support in the project. Under this scheme 1519 bushels of Royal Kidney variety and 4 bushels of Up-to-Date were shipped during the months of February, March and April. Owing to infrequent sailings of the direct steamship service to Liverpool and to difficulties in handling potatoes on these ships, most of the potatoes travelled via New York, and this route though rather more expensive had

the merit of providing a weekly service. The average selling-price of 9/8 per bushel compared favourably with that of 9/4 in 1937, and, thanks to reductions in charges for transport and selling, the average return of 6/6 per bushel compared still more favourably with that of 5/6 last year. Subtracting 1/2 as the cost of crate and packing, we obtain 5/4 as the average price which the grower would have received had not the minimum price been guaranteed. The return to growers from this experimental scheme in 1938 was £480 at a cost to the Government of approximately £73. Grateful acknowledgment is made of the assistance rendered by Messrs. Rogers White & Co. who handled the potatoes in Liverpool.

The Plant Pathologist during a visit to England made a short survey of the market for new potatoes. According to his report the Kidney potatoes from Bermuda are well liked for their flavour and cooking-qualities, but they are not arriving in fresh enough condition to fetch the highest prices. An effort is accordingly being made in the coming season to place the potatoes on the market in a fresher condition with the aid of improved methods of packing and prompt shipment after digging.

GOVERNMENT PACKING OF VEGETABLES AND INSPECTION OF PRODUCE. Vegetables were graded and packed for such growers as wished to avail themselves of this service at the Packing-House in the grounds of the Agricultural Station. Owing to small crops and the difficulty of obtaining labour, the supplementary shed at Southampton was not used. Of the vegetables shipped to Canada 31,152 crates were Government-packed and 26,168 crates (including 9,955 crates of Celery) were farm-packed. As yet the Department has no facilities for efficient packing of celery and all the crop is packed in the field. Of the crates of tomatoes exported, 96% was Government-packed. All the potatoes for England and a small quantity for the United States were Government-packed, while most of the potatoes sent to the United States and all vegetables shipped to the West Indies were packed on the farms.

The Packing-House was as usual under the management of the Inspector of Produce and further information on this branch of work will be found in his Report. As in previous years the cost of packing was not fully covered by the charges made to growers.

All farm-packed vegetables were subjected to inspection on the docks at the time of shipment, and an account of their condition will be found in the Report of the Inspector of Produce.

PLANT PATHOLOGY. Most of the time available for phytopathological research was taken up with a survey of pests and diseases of the Bermuda cedar, *Juniperus bermudiana*. The various organisms identified are described in the Report of the Plant Pathologist, from which account it will be seen that several are capable of causing damage to the trees but none can be pointed out as the chief cause of harm. On many sites poverty of soil, exposure to wind or spray, or overcrowding of the trees is plainly the main factor in the unthrifty condition of the cedars. Elsewhere, however, and particularly in Devonshire and Smith's Parishes the so-called "blight", described in previous reports, appears to be spreading and to be attacking trees growing in ample soil and in sheltered positions as well.

Measures of control have been directed towards increasing the strength and vigour of trees by pruning off dead wood, by thinning out where overcrowding occurs, and by removal of competing sage and fiddle-

wood trees. On the recommendation of the Board of Agriculture the Legislature voted a sum of £1000 towards work for the improvement of cedars. This was spent in a large-scale demonstration to show how cedars should be cared for. A gang of men under the supervision of the Inspector of Produce was trained by the Plant Pathologist in the pruning and thinning of trees, and cedars were treated on certain of the properties affected with the disease, particularly in places where the effect was obvious from a public road. The improvement in the look of the trees and in the general appearance of the properties was most noticeable, and it is hoped that this work has served to demonstrate the many advantages of tending for the trees on an estate.

The Plant Pathologist continued to inspect all importations of plants and was instrumental in stopping several diseases and pests which might have been introduced by this means. Great alarm was felt on account of the Japanese Beetle which causes so much damage in the eastern United States. Specimens of this insect reached Bermuda on ships from New York, but all which were seen were dead on arrival. The Plant Pathologist paid a short visit to the United States to obtain information on this pest and thanks are due to officials of the Department of Agriculture at Washington and New York for the very kind assistance they gave. Following recommendations made in his report on this pest, amendments in the Byelaws for the Control of Plant Diseases and Pests to cover the situation are under consideration.

Other inspection services supervised by the Plant Pathologist included the inspection and certification of Easter Lily fields, and the inspection of plant material to other countries. Advice was given to many farmers and gardeners on the control of diseases and pests. Two horse-drawn spraying-machines were maintained by the Department and were hired out at small cost by the day or half-day to farmers and owners of property.

HORTICULTURE. During the year under review the Horticulturist carried out a full programme of work chiefly along the following lines: (1) encouragement of fruit-growing, (2) experimental work designed to assist the commercial nurseryman, (3) introduction of new plants of ornamental value, (4) advisory work for Arbor Societies, municipalities and other public bodies, private gardeners etc.

The lack of home-grown fruit in Bermuda frequently receives adverse comment and there is no doubt that a wider selection and a larger quantity could be grown if people were prepared to expend a certain amount of time and trouble on them and if effective steps could be taken to check the constant theft of fruit from the trees. For a start the Horticulturist has given particular attention to the improvement of the Loquat, a fruit which can be grown in Bermuda with the greatest ease. By selection, and by introduction and propagation of improved varieties, it is hoped not only to improve the yield and quality of the fruit but to extend the season over which the fruit can be obtained.

The experimental work done by the Horticulturist is fully described in his Report, but particular reference may be made to the successful forcing of gladiolus corms by exposure to the vapour of ethylene chlorhydrin before planting, and to the propagation of Amaryllis bulbs by slicing. Investigations on the commercial cultivation of the Roman Hyacinth are being continued.

Close contact was kept with the work of the Garden Clubs and Arbor Societies and assistance was given wherever possible. Trees and shrubs from the nursery-garden were provided free of charge for planting by roadsides and in other conspicuous places.

During the year many seeds and plants were obtained from different countries and were planted for trial, and this opportunity is taken for thanking all who kindly contributed material for this purpose. Specimens of the Carib-wood of Dominica (*Sabinea carinalis*) one of the most outstanding introductions of recent years, were distributed free of charge.

POULTRY-KEEPING. The Agricultural Assistant gave much of his time to the encouragement of poultry-keeping, and the work done in this connection is described in this Report. Advice was given to poultrymen on the proper feeding, housing, and treatment of their birds and assistance was given in importing stock of high quality. Experimental work at the Agricultural Station included a trial of the battery-system on a small scale. From the results mentioned in the Report of the Agricultural Assistant it will be noted that only the most tentative conclusions as to the value of his system in Bermuda can yet be drawn.

The need for greater co-ordination in the marketing of local eggs has been described in a former section. While on leave in England the Director studied the "National Mark" scheme of the Ministry of Agriculture and Fisheries for the marketing of eggs. Since then a small grading-machine has been purchased and it is hoped shortly to have home-grown tested and graded eggs on the market in bulk.

VETERINARY WORK: (1) **Importation of Animals.** The Government Veterinary Officer examined domestic animals landed in the Colony, with a view to checking the introduction of serious disease. From his Report it will be noted that fewer animals were imported than in the previous year except in the case of poultry. One dog arrived from the United States of America with distemper. The Veterinary Officer submits evidence to show that cattle arriving from other countries are not adequately certified against tuberculosis.

(2) **Health of Dairy Cattle.** The position with regard to the occurrence of tuberculosis in cattle is not altogether satisfactory. The disease occurs amongst cattle in Bermuda to much less extent than in most countries, but in spite of regular testing, followed by slaughter of positive reactors, it appears not to be on the decrease but rather on the increase. During 1938, 1675 cattle were tested out of about 1850 believed to be in the Colony. Most of those which were left untested were in the island of Somerset where no bovine tuberculosis has been found for several years. Of the cattle tested 53, or approximately 3%, were found to react and were destroyed. The following table shows the number of cattle tested and slaughtered in the past five years.

Year	No. of Cattle tested	No. of reactors
1934	1330	19
1935	1470	22
1936	1449	30
1937	1769	42
1938	1675	53

From this table it will be seen that the number of reactors has increased each year since 1934. While this increase may be accounted for in part by the greater number of cattle tested and in part by greater efficiency in detecting reactors, it remains obvious that the disease is far from being eradicated by the existing system and that intensified effort is necessary if this is to be accomplished. The view that its eradication is not impossible is encouraged by the freedom of the island of Somerset from bovine tuberculosis for several years, and by the fact that only two reactors were found during 1938 in the three parishes of Southampton, Warwick and Paget.

At the recommendation of the Board of Health the maximum compensation payable to the owner for a dairy animal slaughtered on account of tuberculosis was raised from seven to ten pounds in the case of a grade animal and from fourteen to eighteen pounds in the case of a registered animal. While this increased compensation was intended to encourage the dairymen, it is open to this objection that the greater the compensation payable the less strenuous are likely to be the efforts made by the dairyman himself to keep his herd clean.

Early in the year a new byelaw was passed requiring dairy cattle known to be infected with actinomycosis to be slaughtered, compensation being payable as for tubercular animals. This disease occurs rarely in Bermuda and only one cow was destroyed during the year on this account. Provision was made for the payment of compensation to a dairyman who slaughters cattle found by the Veterinary Officer to be infected with contagious abortion, the compensation being at half the rate given for a tubercular animal.

OFFICE WORK. The clerical work, involving correspondence on agricultural and departmental matters, the keeping of financial accounts, and the keeping of records in connection with Government-packing, was performed efficiently.

Eight numbers of the Agricultural Bulletin were written and were distributed not only in the Colony but also to Departments of Agriculture and other Institutions in many countries. A paper written by the late Dr. A. B. Rendle, formerly Keeper of the Botany Department of the British Museum, entitled "Notes on the Flora of the Bermudas" was reprinted as a bulletin of the Department with the kind permission of the author and editor of The Journal of Botany.

Many publications were received from Departments of Agriculture and Colleges in different parts of the world, and this opportunity is taken gratefully to acknowledge them.

THE AGRICULTURAL STATION. The grounds of the Department were kept in attractive condition throughout the year. The extensions to the Hospital on the northern boundary caused some destruction, and damage on a smaller scale was caused by dogs roaming through the grounds. It is proposed to construct gates for the entrances so that the grounds can be closed at night. The 29th of August marked the fortieth anniversary of the commencement of the experimental gardens on this property.

Vegetable Plots. The experimental plots were kept planted with vegetables and other crops, most of which were grown for varietal tests or for marketing investigations. Potatoes, tomatoes, carrots and Easter lilies were the chief crops grown in the winter and spring, and on most of the plots cowpeas were planted in the summer and ploughed in as green manure. A small plot of pondland in Pembroke was rented for experimental work on celery.

A portion of the produce was supplied to the Hospital and some of the vegetables were sold locally at times when they did not compete with produce from the farms. Most was used for experimental shipments to various markets abroad.

Ornamental Grounds. Various improvements in the ornamental sections of the grounds were made by the Horticulturist and are described fully in his Report. The plots in front of the Office which are used for annual flowering-plants were re-designed. Improvements were made to the orchard and the banana plot was re-planted. The nursery plot also was cleaned up and planted afresh.

Livestock. A pure-bred Guernsey cow, Beauty of Penn Villa, with her small bull-calf, were purchased from The Emmadine Farms, Albany, New York. The registered Guernsey cow Jane of Montrose, which was raised at the Agricultural Station, and the imported cow, Amazon of Ware, were sold. At the end of the year the small Montrose herd of pure-bred Guernseys consisted of one bull in service, two cows and one heifer in calf, and three bull-calves, two of which are for sale.

Assistance was given to the Horse-Lovers League in their scheme to place out to grass during the summer months a few tired horses in need of rest. One of the pastures was given over to this purpose and stabling accommodation was found.

Visitors. The Agricultural Station was visited by a large number of people many of whom expressed interest in the work being done and in the collection of ornamental and economic plants.

Distingushed visitors included Mr. F. L. Engledow, Professor of Agriculture at Cambridge University, a member of the Royal Commission to the West Indies; Dr. F. J. Seaver, New York Botanical Garden; Dr. S. E. A. McCallan and Norwood C. Thornton, Boyce Thompson Institute; Dr. and Mrs. Nebel and Miss Mary Woodbridge, New York Agricultural Experiment Station. Geneva, N. Y.; Mr. B. F. McCarthy, Bureau of Agricultural Economics, United States Department of Agriculture; Mr. W. D. Lambie, H.M. Trade Commissioner Trinidad; Dr. Arthur W. Hixson, Prof. of Chemical Engineering, Columbia University, N. Y.; the Hon. E. A. T. Dutton, Colonial Secretary, Bermuda, and Mrs. Dutton.

CONFERENCE OF COLONIAL DIRECTORS OF AGRICULTURE, LONDON. During vacation leave, the Director attended the Conference of Colonial Directors of Agriculture held at the Colonial Office in London throughout the last week in July. Many subjects of interest to Bermuda were considered, including soil conservation, land settlement, agricultural training, inspection of produce, and termite control, and these were made the subject of a special report. It proved of great value to meet members of the Colonial Office and agricultural officers in other Colonies, who in some instances were found to be tackling problems similar to those facing this Department in Bermuda.

BOARD OF AGRICULTURE. Ten meetings of the Board of Agriculture were held during the year, and additional meetings of a committee of the Board appointed to consider the question of Cold Storage. All these were attended by the Director as technical adviser, or during his absence on leave by the Acting Director. The frequent changes which have occurred in the Board in the last year or two, and in particular the changes in the Chairmanship, have upset any fixed policy which the Board possessed and have rendered the work of the Department more difficult in many respects.

ACKNOWLEDGMENTS. In addition to the many individuals and institutions mentioned elsewhere in this Report who have given assistance to the Department, acknowledgment is due to Mrs. Thompson of Somerset for a handsome gift of books on horticulture and entomology from the library of the late Col. Wm. Ewers; and to Capt. H. A. Johnstone for a series of excellent photographs of palms.

It is a pleasure to record the loyal and conscientious manner in which officers of the Department have performed their duties during the year.

III. STAFF.

Mr. T. A. Russell, Director of Agriculture, was absent on vacation leave from 2nd July to 20th September. He attended the Conference of Colonial Directors of Agriculture at the Colonial Office from 25th to 30th July. From the beginning of the year till 27th June he served on the Board of Immigration.

Mr. J. M. Waterston, Plant Pathologist, acted as Director from 2nd July to 8th August. He was on vacation leave from 13th April to 28th June, and he paid an official visit to Washington and New York from 17th to 26th August to formulate measures for preventing entry of Japanese Beetle into Bermuda.

Mr. W. R. Evans, Agricultural Assistant, acted as Director from 9th August to 19th September. He was absent from the Colony on duties connected with the marketing of vegetables in Canada from 7th May to 23rd July and was on sick leave from 25th July to 8th August.

Mr. G. R. Groves, Horticulturist, in addition to his normal duties, supervised work on the experimental plots in the absence of the Foreman from 19th October till the end of the year.

Mr. T. A. Hollis, Inspector of Produce, was responsible for the running of the Government Packing-House in addition to his inspecting duties. From 15th August till the end of the year he supervised the pruning and thinning of cedars under the Control of Cedar Diseases Resolve.

Miss Nora E. Hollis, Clerk to the Board and Director, was responsible for the clerical work and book-keeping of the Board and Department, and of the Packing-House. She was granted sick-leave from 5th September to 17th September.

Dr. C. J. Cooper, Government Veterinary Officer, was absent from the Colony from 3rd to 16th July in order to attend the American Veterinary Congress in New York. During this period the veterinary duties were done by Dr. J. W. Sutherland.

Mr. C. V. S. Early, Station Foreman, acted as Assistant Inspector of Produce during the shipping-season. He was on vacation leave from 19th October till the end of the year.

IV. FINANCIAL.

The Expenditure of £3,408 in Personal Emoluments was authorised by the Appropriation Act of 1937, and of this sum £3,066. 16. 1. was expended. The sum of £7,970 was appropriated for other purposes by the Appropriation Act of 1937 and by Supplementary Resolves No. 11 of 1938 and No. 2. of 1939, and £5,896. 10. 6. was spent. Reimbursements to the Treasury for charges made for packing vegetables and for the sale of plants amounted to £1,119. 0. 11. The nett expenditure of the Department, exclusive of Personal Emoluments, was therefore £4,697. 9. 7. The following table shows the corresponding figures for the past ten years.

Year	Gross Expenditure	Reimbursements	Nett Expenditure
1929	£ 4,184 6 10	£ 193 0 1	£3,991 6 9
1930	6,500 16 2	247 18 9	6,252 17 5
1931	6,984 18 9	280 1 1	6,704 17 8
1932	6,745 2 4	466 7 1	6,278 15 3
1933	10,191 17 0	2,434 9 7	7,757 7 5
1934	9,905 10 11	2,409 6 9	7,496 4 2
1935	6,570 16 10	3,163 18 11	3,406 17 11
1936	5,999 16 4	1,813 5 2	4,186 11 2
1937	4,973 3 5	846 2 5	4,127 1 0
1938	5,896 10 6	1,199 0 11	4,697 9 7

In addition to these departmental votes, financial assistance was given by the Government to Agriculture by the payment of a subsidy from votes of the Trade Development Board to provide increased facilities for the shipment of vegetables.

Respectfully submitted,

T. A. RUSSELL,

Director of Agriculture.

27th February, 1939.

Report of the Plant Pathologist, 1938.

The Director of Agriculture,

I have the honour to submit a report of my observations and research work on plant diseases and pests during the year 1938.

GENERAL REVIEW

There were several outstanding epidemics of diseases and pests of economic crops during the year under review. In early January, a very heavy loss of Bliss Triumph potatoes was suffered, as a result of black-eye rot, caused by the fungus *Phytophthora infestans* (Mont.) de Bary. This was due to the fact that the crop was attacked by blight towards the end of December of the previous year just before digging, with the result that the potatoes were exposed to infection by the fungus as they were dug and rapidly rotted when held in storage. This late blight attack on the Triumph crop had important consequences. In far too many cases, as soon as the Triumphs were dug, another crop of potatoes, Irish Cobblers, Katahdins or Garnets were planted in the same piece of ground, in soil which was already contaminated with spores of the blight fungus, and amongst Triumph culls and volunteer plants infected with blight. As could only be expected under such circumstances, the new crops of potatoes were attacked by blight before the plants were well out of the ground, and could not be saved by any amount of spraying. The practice of rotation in Bermuda is difficult owing to the limited choice of cash crops available and profitable for cultivation. Every effort is being made to encourage farmers to adopt routine spray schedules for their crops and to pay more attention to clean cultivation.

Owing to exceptionally dry weather experienced during March and April, the Irish Cobbler potato crop suffered badly from an attack of Common Scab, caused by *Actinomyces scabies* (Thaxt.) Güssow. This disease was abundant in areas with light dry soil and less common on the heavier clays or damper soil of the pondlands. Many potatoes could not be shipped on account of this disease. A green manure crop of cowpeas or soy beans, ploughed under about the middle of June, would do much to reduce the incidence of this fungus.

Part of an experimental shipment of Kidney potatoes to England, arrived infested with Tuber Moth, *Phthorimaea operculella* Zell., and 27 packages were condemned. The shipment however, was made late in May, and it is not anticipated that the pest will occur earlier in the season to prove an obstacle in the future development of this potential market for Early Bermuda potatoes.

The incidence of virus in the Bliss Triumph crop was much higher this year in spite of precautions taken to prevent the importation of seed from fields in Nova Scotia which showed these diseases in excess of one half of one per cent on their first inspection. Leaf Roll counts at the Agricultural Station in December showed an 18 per cent infection.

Other shipments of Bliss Triumph seed potatoes made in September were unsatisfactory on account of the high incidence of *Phytophthora*

black-eye rot. One shipment of 400 barrels showed on examination up to 8 per cent infection, whilst a later shipment with 25 per cent infection was condemned as unfit for seed purposes.

The weather during October and November was abnormally wet and mild, high winds being absent. Early planted Triumph potatoes from Bermuda seed and strawberry plants were badly damaged by fireworms, *Xylomiges eridania* Cram., leaf rollers, *Psara periusalis* Wlk., and cutworms, *Feltia subterranea* F., which were present in enormous quantities as a result of favourable weather conditions. The yield of potatoes obtained was very poor even where the crop was sprayed, whilst neglected fields were completely destroyed. The extent of the cutworm infestation during November may be gauged by counts of larvae made on putting greens of Domestic Rye grass at Riddell's Bay Golf Course. Counts of cutworms visible on the surface of the young grass gave numbers which varied from 3 to 5 per square foot, representing a total of between 12,000 to 20,000 cutworms per green of 4,000 sq. feet. Little difficulty was experienced by the groundsmen in collecting 1½ gallons of cutworms, from one green alone.

Effective control measures used against this pest, consisted of applying a poison bran mash, made up of 10 lbs. Pollard mixed with 1 lb. of Paris Green. The later planted Triumphs made much better growth but suffered severely with other crops from heavy winds and hail experienced towards the end of December.

One result of the dry weather was the absence of celery blight, *Septoria Apii* Chester, and the celery crop proved one of the best on record. The drought continued until the end of May and affected the yield of tomatoes, carrots and beets. Following heavy rains at the beginning of June, Anthracnose disease of Watermelons, *Colletotrichum lagenarium* (Pass.) Ell. & Halst., caused considerable damage in St. David's Island. This disease has only become prominent during the last two years and routine spraying of the crop with Bordeaux would appear to be desirable.

Apart from the damage caused by these outstanding diseases and pests, the amount of wastage to agricultural produce which occurred during the period between harvesting the crop and its arrival on the Canadian Market was as high as in previous years. This wastage is unnecessarily excessive on account of the lack of adequate cold storage facilities. As a result, heavy shipments are made by infrequent steamships so that a large volume of produce has to be accumulated on the dock before shipment overseas. It is a noteworthy fact that the amount of wastage due to the fungus *Sclerotinia sclerotiorum* (Lib.) de Bary is frequently higher in Government packed produce than in the Farm packed. The reason for this is that in the latter case there is less delay between the time of lifting and shipping. In my report for the previous year, attention was drawn to the necessity for proper facilities for pre-cooling if the problem of reducing unnecessary wastage is to be solved. Until there is a pre-cooling plant on the dock in which the produce can be placed as soon as it is reaped, losses of this type will continue to the detriment of the farmer and of the Colony as a whole.

The most outstanding event of the year from the view of quarantine work was the arrival of dead Japanese beetles, *Popillia japonica* Newm., on board vessels of the Furness-Bermuda line during July. An account of the action taken by the Department will be found in a later part of this report.

A considerable amount of time was spent during the latter half of the year in putting control measures against cedar diseases into operation. On the recommendation of the Board of Agriculture, the House of Assembly passed a Supplementary Appropriation Resolve (No. 11) 1938 for £1,000 for the Control of Cedar diseases on 2nd August. This grant was utilised to train and equip a Government Forest Gang which co-operated with Arbor Societies and landowners in thinning, pruning and spraying trees where this was urgently required. Attention was also drawn to the widespread damage done to woodwork of all kinds in buildings due to the ravages of the common powder post termite, *Kalotermes* (*Cryptotermes*) *brevis* Walk., and it is gratifying to note that a start has been made by interested persons in the eradication of these pests from buildings by means of various chemical treatments. A proprietary liquid called "Rentokil" has been found very effective in killing dry wood termites *in situ*. Tests have not been conducted long enough yet to determine whether wood treated in this way will remain free from reinfestation.

MAJOR PROBLEMS INVESTIGATED

The amount of time available for research work was meagre. Much time was occupied by routine Inspection Services, particularly that of the Inspection of Plant Importations. This service, whilst of vital importance to the Colony, is yearly becoming a more arduous task and is occupying a disproportionate amount of time of the Plant Pathologist. The appointment of a Plant Protection Officer, trained in Inspection Services and working under the close supervision of the Plant Pathologist, would not only prove of invaluable assistance to the latter Officer, but would enable a far more comprehensive programme of research work to be carried out.

SOIL SURVEY.

Early in August, 1937, a preliminary soil survey of Bermuda was made with the aid of the Agricultural Assistant. Full-depth profile samples were procured from ten representative localities and forwarded for analysis to Mr. F. Hardy, Professor of Chemistry and Soil Science at the Imperial College of Tropical Agriculture, Trinidad, B.W.I. Owing to the high lime status of the soil, some trouble was experienced in determining the amounts of available phosphate and potash present in the samples but the laboratory results for the composite surface six inch layers of the series are now to hand. As full details of the analysis will be published separately, it will suffice here to remark briefly on the salient features.

The soil reaction was found to be highly alkaline (pH 7.5 - 7.8), the total nitrogen content, available phosphate and potash all being very high. As a result of the medium-low rainfall experienced in Bermuda (annual average about 54 inches) Prof. Hardy suggests that soil texture is a very important factor in relation to soil fertility. He concludes that the nutrient status is probably seldom or never the limiting factor in crop production in Bermuda but rather the moisture relations of the soil. Field studies along these lines are being continued by the Department.

DISEASES AND PESTS OF THE BERMUDA CEDAR, *JUNIPERUS BERMUDIANA* L.

Work on cedar blight was continued during the year as time permitted. Various species of mites, insects and fungi were collected from cedars in areas where the trees were in a badly defoliated condition. None

of these have however proved to be primary parasites on further investigation and a great deal of the trouble affecting the cedars appears to be due to physiological causes. The chief of these is overcrowding. An annotated list of pests and diseases is given below.

Pests.

The following mites have been collected from the basal leaves of blighted cedar foliage, where evidence of damage by chewing was found. Species belonging to the Oribatoidea, were examined by the French authority Dr. Grandjean who identified them provisionally as follows:—

1. *Scapheremaeus* Berlese 1910 sp.n?
2. *Lucoppia* Berlese 1908 sp. n?
3. Tritonymph of a species of *?Micreremus* Berlese 1908.

The Oribatids lead a cryptozoic life among moss, in rotting vegetable matter, under bark, stones and pieces of wood, and are of no economic importance. Other species belonging to the Gamasidae and Tetranychidae were also recorded. While the former are usually predatory on other mites, or small insects, or parasitic on beetles, small mammals, birds etc., the latter are of economic importance in that they feed on plant juices and sometimes occur in large numbers. Those found on the cedars will be studied further.

Several species of psocids have been taken which were identified by the Imperial Institute of Entomology as follows;—Lepidopsocidae; *Lepidilla* sp. n., Psocidae; *Psocidus* sp. n. Trogiidae; *Hyperetes guestfalicus* Klb. var?

Commenting on the type of damage liable to be caused by the psocids, Mr. J. V. Pearman predicted that experiment would most likely show *Hyperetes guestfalicus* and *Lepidilla* sp. to feed indifferently on some fungi, algae, dead plant matter, decaying fruit, empty galls, insect bodies and eggs, and that the *Psocidus* sp. would be chiefly interested in algal growths but might be to some extent entomophagous. The results of experiments carried out with these psocids found on cedars, have so far confirmed Mr. Pearman's suggestions.

Other more widespread pests of cedar foliage in Bermuda are the Singer, *Cicada bermudiana* Verrill, the Green Cedar Berry bug, *Banasa euchlora* Stal., the Grey Hopper, *Ormenis infuscata* St. an undetermined species of *Deltocephalus,* (Jassidae), a scale-insect, *Chrysomphalus agavis* Ths. & Ckll., and the larvae of a Geometrid moth, *Alcis verrillata* Dyar., (Geometrinae.)

The living tree is attacked through wounds or dead branches by the larvae of bark boring beetles, *Oeme linearis* Harris and *Leptostylus praemorsus* F., but by far the most serious damage is caused by a species of Dry Wood Termite, *Kalotermes approximatus* Say, which can completely hollow out the trunk. Besides attacking cedar trees, Dry Wood Termites cause considerable damage to timber of all kinds in the Colony. Another species determined by the British Museum as *Kalotermes* (*Cryptotermes*) *brevis* Walk. infests the woodwork in buildings and other structures often with serious consequences. Various chemical treatments for protecting wood against termite attack are at present under investigation.

Diseases.

Second in importance to the termite damage, is the Red Rot fungus, which has been identified by Miss E. M. Wakefield as *Fomes subroseus* (Weir) Overholts. The fungus gains an entrance to the tree in the same manner as the termites, through old wounds or dead branches. Trees thus affected are rendered useless for commercial purposes, and as in the case of trees attacked by dry wood termites, are a potential source of danger to persons and property in the event of a hurricane owing to the ease with which they are blown down in high winds.

One of the most important fungi found attacking the foliage is the cedar rust, *Gymnosporangium bermudianum* (Farl.) Earle, which appears as small round red galls on the twigs. Death of the infected twigs often takes place in those portions distal to the point of infection. The attack of this fungus is restricted to individual trees which may often suffer severe defoliation.

A very common fungus found associated with blighted foliage has been determined by the Imperial Mycological Institute as *Pestalotia unicolor* Berk. & Curt. Experimental work with pure cultures has shown that the rôle played by this fungus is that of a secondary invader and not that of a primary parasite.

The similarity of some of the symptoms of local cedar diseases with the North American cedar blight caused by *Phomopsis juniperovora* Hahn, has led to a diligent search for species of *Phomopsis* on cedar in Bermuda. So far, no fungus corresponding to this description has been found.

A fungus which may possibly prove to be parasitic, has been provisionally identified by Dr. Seaver as *Laestadia juniperina* (Ellis) Sacc. The perithecia were very abundant on the dead leaves of cedar foliage, collected from a patch of cedar blight in Southampton. The pathogenicity of this fungus will be further studied. Various species of fungi belonging to the Sphaeropsidales, and including a species of *Coniothyrium* have been isolated from blighted cedar foliage and are also being investigated.

Two operculate discomycetes, *Pithya Cupressi* (Batsch) Rehm, and *Pseudopithyella minuscula* (Boud. & Torrend) Seaver, found on dead cedar foliage, are at present under observation. Other species of fungi recorded from Bermuda Cedar which appear to be purely saprophytic are *Hypocrea patella* Cooke & Peck, *Pleurotus niduliformis* Murrill, *Polystictus pinsitus* (Fr.) Cooke, and ?*Bulgaria melastoma* (Sow.) Seaver.

Measures Adopted for Control of Cedar Diseases.

As has previously been mentioned, an investigation of the chief pests and diseases associated with the blighted condition of cedars yielded no evidence for the existence of any one primary parasite. On the other hand, there was a great deal of evidence for suspecting that neglected conditions leading to overcrowding, competition and shading effects, were causing physiological disturbances and predisposing the cedars to the depredations of secondary agencies. A common succession of organisms observed to follow shading effects is that of mites and *Pestalotia unicolor* Berk. & Curt. on the foliage, which may sometimes be accompanied by *Chrysomphalus agavis* Ths. & Ckll. Larvae of the bark boring beetles *Oeme linearis* Harris

and *Leptostylus praemorsus* F. then follow, their tunnels eventually stripping the bark and paving the way for the Dry Wood Termites, *Kalotermes approximatus* Say, or the Heart Rot fungus, *Fomes subroseus* (Weir) Overholts, both of which finally destroy the heart of the tree and render it useless for commercial purposes.

Every effort was made during the year to encourage landowners to adopt pruning and thinning operations on their estates with a view to improving the strength and vigour of their trees so that they might successfully withstand attack by insects and fungi. It was stressed that this could only be achieved by proper attention to sylvicultural details. An exhibit showing some of the chief diseases and pests of Bermuda cedar, and the methods whereby these could be checked, was arranged at the Agricultural Station. This was kept open to the public during the whole year and was well advertised, but in spite of this the attendance was discouraging. A better response was obtained from Utility Companies and Government Departments, and employees of the Telephone Company, Electric Light Company, Public Works Department, Health Department and men from the Royal Engineers, who were all given instruction in the care of cedars. A course in Forestry for Boy Scouts was also put into operation.

Active co-operation was obtained from the Smith's Parish Arbor Society who aided in a survey of the trees in Devonshire and Smith's Parishes. Government assistance in the form of an Appropriation of £1,000 for the Control of Cedar diseases, was obtained and utilised to form and equip a Forest Gang, trained in the proper methods of thinning, pruning and spraying of trees, with the object of helping landowners to carry out the necessary measures for the control of diseases on their own estates and to prevent their further spread to adjoining properties. Landowners were expected to assist wherever possible by contributing towards the expenses either in cash, lumber or by providing labour.

The Work of the Government Forest Gang.

The Forest Gang started work under the supervision of the Inspector of Produce, Mr. T. A. Hollis, who acted as Foreman, on 15th August and terminated their operations on 27th December. During this period, trees on 29 estates were treated; 17,261 diseased trees pruned; 9,466 diseased trees removed and 690 Fiddlewoods, *Citharexylum spinosum* L., also destroyed. Major operations were confined to Devonshire and Smith's Parishes and minor tasks were performed in Pembroke and in Somerset. The Sandys Garden Club co-operated by donating cash and labour towards expenses in the latter Parish. The work of the Forest Gang throughout the Colony has provided Demonstration Areas which will be valuable for instructing property owners in the proper care of their trees.

ATTEMPTED ESTABLISHMENT OF *DASYSCAPUS PARVIPENNIS* GAHAN.

An attempt was made at the beginning of the year, to establish the parasite *Dasyscapus parvipennis* Gahan in Bermuda with the object of the biological control of the onion thrips, *Thrips tabaci* Lind. Two shipments were supplied by Dr. A. M. Adamson of the Imperial College of Tropical Agriculture, Trinidad, B. W. I., and were transported by aeroplane through the courtesy of the Imperial & Pan American Airways by kind permission of the Bureau of Entomology and Plant Quarantine, Washington, D.C. Shipments were made in the pupal stage, the host insect being the Cacao thrips, *Selenothrips rubrocinctus* Giard.

The first shipment of 1,000 pupae arrived on 17th January. Although due to emerge on the day of arrival, none were observed until eleven days later when four males were found. The low temperature experienced (62°F.) may partly explain the delayed emergence and the apparent lack of activity displayed by the insects when emerged. Food in the form of raisins was offered in the hope of prolonging the life of the males until the females appeared but no further emergences occurred.

A second shipment of 3,000 pupae was received by air on 7th February, which was in much better condition than the previous one. Fifty-four wasps were already emerged at the time of arrival and the subsequent rate of emergence is shown in Table I.

TABLE I.

Rate of emergence of *Dasyscapus*

Daily totals of emergences during February.

	7th	8th	9th
Males	52	59	95
Females	2	18	108
TOTAL	54	77	203

On 10th February, 150 females which had previously been mated, were liberated on a plot of onions at the Agricultural Station infested with *Thrips tabaci* Lind. together with 40 males and 810 pupae.

On 11th February, a second batch of 1,000 pupae, from which had emerged 20 females and 30 males, was kept with 50 onion thrips in a glass container in the greenhouse.

Recoveries. The weather experienced at the time of liberation could not be regarded as favourable, being cool (58°F.), dull and windy. As a result, few recoveries were made. One recovery in the greenhouse and three in the field were made on 8th March, but none were further recorded subsequently. Whilst these records can hardly be treated as significant they are at least encouraging for further attempts at the introduction of the parasite.

WORK DONE ON DUTY LEAVE

The presence of dead Japanese beetles, *Popillia japonica* Newm., arriving on board vessels of the Furness-Bermuda Line at Bermuda during the latter half of July and the beginning of August, gave rise to fears that this dangerous pest might eventually become introduced in a viable condition and establish itself in these Islands. A consultation with Federal and State authorities visited in the United States of America whilst on duty leave between 17th to 26th August, inclusive, showed that these fears were fully justified. Both from her geographical position and abundance of host plants, Bermuda appears particularly vulnerable to invasion. The dry sandy soil might however prove unsuitable for the establishment of this pest during the summer months. The enforcement of quarantine regulations requiring the certification of all farm produce entering the colony from 1st June to 30th September was suggested as one means for preventing the

introduction of the adult beetle. This certification would also apply to other forms of plant life imported during this period. A revision of the existing Bye-laws for the control of plant diseases and pests is being undertaken at the present time on the lines recommended above.

Bermuda is already adequately protected against the possibility of an introduction of the larval stage in soil around the roots of potted or balled nursery stock. This quarantine against soil entering the colony should be strictly maintained since there are other equally dangerous pests such as the Asiatic Garden Beetle, *Autoserica castanea* Arrow and the Oriental Beetle, *Anomala orientalis* Waterhouse as well as the White-Fringed Beetle, *Naupactus leucoloma* Boh., all of which may be introduced by similar means.

The use of traps for scouting purposes is strongly recommended and these will be established in the neighbourhood of the docks and the airport in order that an early warning of the presence of the beetle in Bermuda may be obtained.

WORK DONE ON VACATION LEAVE

Whilst on vacation leave from 13th April to 28th June, inclusive, I investigated the marketing of Bermuda Royal Kidney potatoes in England. The market during the months of February to April appears assured if potatoes of the required quality, possessing loose skins, can be produced. This should not be difficult if the tubers are packed in peat moss.

In addition to the above investigation, the following places were visited in connection with work on plant pathology in Bermuda;—The Colonial Office, the Universities of Cambridge, Edinburgh and Reading, the Kew Herbarium, the Imperial Mycological Institute, the British Museum of Natural History, the Rothamsted Research Station, the Ministry of Agriculture and Fisheries' Plant Pathological Laboratory and the Forest Products Research Laboratories at Princes Risborough.

OFFICE WORK

The Office work included correspondence on plant pathological matters and the writing of monthly reports.

Special reports on the following subjects were submitted to the Board of Agriculture:—

"On Work Done during Vacation Leave". Dated 30th June 1938.

"On the Marketing of Bermuda Royal Kidney Potatoes in England." Dated 1st July 1938.

"On Measures for the Control of Cedar Diseases". Dated 1st July 1938.

"On the Menace of the Japanese Beetle". Dated 13th August 1938.

"On a Visit to the United States of America to Investigate the Danger of an Introduction of the Japanese Beetle into Bermuda". Dated 28th August 1938.

Articles were contributed to the Department's Agricultural Bulletin and to the local press. The library and equipment were maintained in good order, additional apparatus being acquired as funds permitted. Laboratory facilities were extended to Dr. Fred Jay Seaver for a fortnight during December. Mr. J. Osborn, an undergraduate of Cornell University, gave valuable assistance in both field and laboratory work during the summer months.

ADVISORY WORK

There was an encouraging demand for advice on the control of diseases and pests and this was freely given to farmers and gardeners throughout the year. The total number of lectures delivered on plant pathological matters was eleven and included addresses to Schools, Teachers, Clubs, Farmers' Meetings, Arbor Societies, Boy Scouts, Government Departments and Public Utility Companies. In addition, practical demonstrations in disease control were staged, particular emphasis being laid on the value of routine spray schedules. An exhibit arranged at the Agricultural Station to show the chief methods of control of diseases and pests was kept open throughout the year.

INSPECTION SERVICES

Lily Inspection. The first inspection of the lily fields was delayed by wet weather and took place during the period January 17th — 31st, and the second was carried out between 5th — 10th April. Out of a total of 40 fields inspected, 39 passed the final inspection, giving an area of 5,024 sq. rods or 31.4 acres, an increase of 467 sq. rods over the area recorded for last year. One field only was condemned on account of rosette disease.

Inspection of Plant Importations. During the year I inspected 384 packages of imported plants and bulbs. The total for this year was the highest on record as the following figures show:

TABLE II.

Year.	No. of Consignments Examined at Post Office and Docks.
1932	262
1933	269
1934	257
1935	300
1936	318
1937	298
1938	384

The task of inspecting the plant importations is increasing and occupies much valuable time which could otherwise be devoted to research. The importance of the Inspection Service can be gauged by the following record of interceptions. The total number of packages passed at the time of inspection was 345, while 3 were passed after treatment with hydrocyanic acid gas. In 36 cases, plants or bulbs were confiscated or destroyed. These included citrus trees from a prohibited area and lily and narcissus bulbs imported contrary to Bye-laws. Other violations of the Bye-laws were the importation of plants by aircraft on 2 occasions; the importation of plants in soil without a permit on 6 occasions; the importation of sweet potatoes from the West Indies on 4 occasions and raw carrots from the United States on 3 occasions. Noteworthy interceptions of serious diseases and pests were as follows:—

TABLE III.

Disease or Pest	Country of Origin	Material
Anastrepha mombinpraeoptans Sein, West Indian Fruit Fly	B. W. I.	Mangoes
Lepidopterous larvae	"	Pineapples
**Otiorrhynchus sulcatus* Fab. Vine Weevil	England	*Cestrum aurantiacum* Lindl.
Popillia japonica Newm., Japanese Beetle	U. S. A.	Vessels plying between New York and Bermuda.
Pyrausta nubilalis Hubner, European Corn Borer	U. S. A.	Raw corn cobs
Ustilago Zeae (Beckm.) Unger. Corn Smut	"	" " "

Facilities for the inspection of plants have been very poor in the past at the Hamilton Post Office. The provision of a table near a well-lighted window, through the courtesy of the Colonial Postmaster, has greatly improved Inspection work.

Inspection of Plant Exportations:—The number of consignments of plants and bulbs examined and certified as free from diseases and pests previous to their being exported was 150, an increase of 24 over the number of last year.

Inspection of Vegetable Seed:—Celery seed from France had a high percentage of *Septoria* blight, counts of various samples ranged from 4% to 7%. All seed was treated with organic mercury dust before being released for distribution to growers.

SPRAYING SERVICES

The two motor sprayers were maintained in working order throughout the year, one being kept at Southampton and the other at the Agricultural Station. They were employed together on 131 occasions, an increase of 36 over the total for the previous year, chiefly for spraying potatoes, tomatoes, celery, lilies, palms, oleanders and other ornamental shrubs. Hand dusting machines were employed on potatoes, tomatoes and ornamental plants in the Station grounds. Supplies of oil emulsion were maintained and distributed when required for the control of scale insects and mealy-bugs.

DISEASES AND PESTS OBSERVED DURING THE YEAR

The Weather. The profound influence of the weather on the incidence of the diseases and pests recorded during the year has already been dealt with at the beginning of this report.

* Previously intercepted on plants from England by L. Ogilvie in 1925.

Notes on Diseases and Pests.

Beans, Lima. Severe damage was caused by a species of *Phyllostícta* associated with leaf lesions caused by *Bacterium Phaseoli* EFS. in October. Rust, *Uromyces Phaseoli* (Pers.) Wint., caused slight damage during December in Devonshire pond-land.

Carnation. Wilt disease, *Fusarium culmorum* (W. G. Sm.) Sacc., caused some losses in plants obtained as cuttings from England. Rust, *Uromyces Dianthi* (Pers.) Niessl., was kept under control by dusting with sulphur. Red Spider Mite, *Tetranychus telarius* L., was troublesome in May and June. Good control was obtained by the Horticulturist, by spraying the plants once a week with a mixture of liver of sulphur (½ oz.) and soft soap (1 oz.) in one gallon of water.

Carrots. *Sclerotinia sclerotiorum* (Lib.) de Bary, was not observed to cause much damage in the field but was responsible for losses during transit to the Canadian market.

Celery. A little Blackheart was recorded towards the end of March.

Chrysanthemums. Eelworm blight due to *Aphelenchoides Ritzema-bosi* Schwartz, was severe during the summer months. The damage due to these organisms has been overlooked in the past.

Cockroaches. The "Croton Bug", *Blatella germanica* L. proved a nuisance in stores and buildings in September, but was effectively controlled by baiting with phosphorus rat poison. *Periplaneta americana* L. was observed to damage the cotyledons of annual seedlings under glass in October.

Crab-grass. Brown Spot on turf due to species of *Rhizoctonia* and *Fusarium* was found in February at Tuckers Town. Satisfactory control was obtained through the use of Organic Mercury compounds. Damage resulting from excessive application of Nitrate of Soda was recorded from Paget in January.

Cucumbers. Soil treatment with Formalin was found to greatly reduce the incidence of the Root Knot Nematode, *Heterodera marioni* (Cornu) Goodey in greenhouses. *Sclerotinia sclerotiorum* (Lib.) de Bary was also troublesome in greenhouses in December.

Damping-Off. Seedling Stocks at the Agricultural Station were lost due to damping-off by *Rhizoctonia* (*Corticium vagum* B. & C.) in October. No *Phytophthora* was found associated with this condition although diligently sought.

Freesia. Foot Rot, *Fusarium bulbigenum* Cooke & Massee caused some losses in the field early in the year.

Gladioli. The leaf hopper, *Empoasca fabae* Harr., did considerable damage to foliage early in the season, while the mild weather towards the end of the year encouraged unusually large numbers of *Taeniothrips simplex* Morrison which severely damaged the flowers.

Grapes. The grape vine Phylloxera, *P. vitifoliae* Fitch, was discovered on an isolated vine in Pembroke Parish during July and the vine was destroyed. This pest is only rarely found in Bermuda.

Lettuce. Marginal Blight, *Bacterium marginale* Brown, affected Big Boston and Improved Hansen varieties during February. Lettuce Drop, *Sclerotinia sclerotiorum* (Lib.) de Bary was prevalent from January to March.

Lilies, Easter. Stump rot, *Phytophthora parasitica* Dast., was locally severe during wet weather in January where soil wash was present. Black Scale, ? *Colletotrichum gloeosporioides* Penz. has been provisionally named the fungus responsible for this condition in the bulb and for a premature die-back of the plant in the field.

Loquats. A die-back of branches at the time of flowering in November, was provisionally assigned to the fire-blight organism, *Bacillus amylovorus* (Burrill) Trevisan.

Papaw. The Mediterranean Fruit Fly, *Ceratitis capitata* Wied, was observed on the fruit of a neglected tree in St. David's Island in January. Powdery Mildew, *Oidium Caricae* Noack, was prevalent during the winter months especially on young seedlings which were severely attacked.

Salsify. White-Blister, *Cystopus cubicus* (Strauss.) de Bary was destructive in the spring on young plants.

Tomatoes. Leaf Mould, *Cladosporium fulvum* Cooke, was severe on plants in St. David's Island, late in December. *Sclerotinia sclerotiorum* (Lib.) de Bary, was common on "bushed" tomatoes towards the end of the year. Green Fruit Rot, *Phytophthora parasitica* Dast. emend. Ashby, was recorded during wet weather in December. Blossom End Rot, was prevalent during dry weather at various times during the year.

FUNGI AND INSECTS COLLECTED

The number of specimens of fungi collected during the year was over 200. Most of these were collected with Dr. Fred J. Seaver, Curator of the New York Botanical Garden, during his visit to the Colony from 28th November to 14th December. Dr. Seaver is at present working on the material collected and has promised duplicates of all named specimens for the Department's Herbarium. The total number of fungi recorded from Bermuda is 343, exclusive of the present collection. In addition there are 89 species of Lichens recorded. The Myxomycetes have not been systematically collected, apart from 22 species recorded by Prof. H. H. Whetzel. An annotated list of Bermuda Fungi is in the course of preparation. The following fungi, new to Bermuda, have been determined by Miss E. M. Wakefield:—*Auricularia polytricha* (Mont.) Sacc., on an old stump of Fiddlewood, *Citharexylum spinosum* L., and *Peniophora cinerea* (Pers.) Cooke, saprophytic on Crown Gall (*Bacterium tumefaciens* Smith and Townsend) on *Acalypha Wilkesiana* (Muell.) Arg.

Collections of insects have been made, chiefly dry wood termites and pests of cedar trees. These will be found described under the latter heading, elsewhere in this report.

RECORD OF MOVEMENTS

I was absent from the Colony on Vacation Leave in the United Kingdom from 13th April to 28th June inclusive. I acted as Director of

Agriculture during the period 2nd July to 8th August inclusive and was absent from the Colony on Duty Leave in the United States of America from 17th August to 26th August inclusive.

ACKNOWLEDGMENTS

It is a pleasure to record my indebtedness to Mr. Avery S. Hoyt, Acting Chief of the Bureau of Entomology and Plant Quarantine U.S.D.A., and to the numerous officials of his Department, for their courtesy and kind co-operation in placing every available assistance within their means at my disposal during my brief visit to the United States of America.

I am also indebted to the following research workers and Institutions for aid in research problems and questions of nomenclature:—Prof. A. M. Adamson, Entomology Department and Prof. F. Hardy, Chemistry and Soil Science Department of the Imperial College of Tropical Agriculture, Trinidad, B.W.I.; The British Museum of Natural History; Sir Guy A. K. Marshall, Director, Imperial Institute of Entomology; Mr. S. F. Ashby, Director, and Mr. E. W. Mason of the Imperial Mycological Institute; Miss E. M. Wakefield of the Kew Herbarium, Mr. W. P. K. Findlay, the Forest Products Research Laboratories, Princes Risborough and Dr. Fred J. Seaver, Curator, New York Botanical Garden.

Respectfully submitted,

J. M. WATERSTON,

Plant Pathologist.

12th January, 1939.

Report of the Agricultural Assistant, 1938.

The Director of Agriculture,

I have the honour to submit my report for the year 1938.

I was absent from the Colony serving as Marketing Officer in Canada from the 7th May to the 23rd July. I was granted sick leave from 25th July to 8th August and from that date till 20th September acted as Director of Agriculture in the absence of the Director on leave.

IMPORTATION OF SEED POTATOES. Conditions unfavourable to potato growing were experienced in Eastern Canada during the Summer and Fall months and consignments of Bliss Triumph seed imported into the Colony had to be carefully examined for the presence of Phytophthora blight rot. A shipment of 400 barrels of Bliss imported in the Lady Nelson 12th September was found on inspection to be affected with Phytophthora blight rot amounting to from one to eight per cent. This shipment was passed by a Committee of the Board, the importer undertaking to compensate the farmers for any loss incurred through rotting prior to planting.

Another shipment of 40 barrels badly affected with rot was received on the Lady Hawkins 26th September. In this instance the shipment was condemned as unfit for seed purposes and the importer was permitted to pick them over to sell for eating purposes. While the field results from the Fall Triumph crop have not yet been ascertained it is anticipated that the crop will be the smallest in several years; germination in the fields was particularly uneven and the heavy winds experienced during the middle of December completely destroyed the tops of the promising plantings except in such fields as were sheltered from the north-west winds. Much virus infection was seen on several farms. The experimental planting of approximately 20 rods at the Agricultural Station contained an infection of 18% mild leaf roll and 1% mosaic.

THE IMPORTATION OF POTATOES ACT, 1938. An Act enabling the Governor-in-Council to prohibit the importation of potatoes by an Order-in-Council was passed by the Legislature in July. An order-in-Council prohibiting the importation of potatoes under penalty of an extra duty of 5/- per bushel became effective on 1st August and it became my duty as Acting Director to administer the order. From information obtained from returns of potatoes sold between August 1st and September 26th it was possible to determine the approximate average daily consumption of potatoes in the Colony. The returns for this period showed that potatoes were used at a rate of approximately 45 barrels per day. As the consumption of potatoes during the late summer months is probably less than at any other period of the year, it is estimated that the Colony's average daily consumption is approximately 50 barrels, or 18,250 barrels a year. The reaction of the public to this new legislation was not as unfavourable as might be expected. Several complaints were received towards the end of the prohibition period that the potatoes offered for sale were undersized and wasty, and our observations confirmed the truthfulness of several such complaints. If similar legislation is contemplated another year, means should be adopted to prevent a similar occurrence.

POULTRY IMPROVEMENT WORK. The efforts of the Department in re-organising the Bermuda Poultry Association in October 1937 proved fruitful. Early in 1938 steps were taken to revive the Annual Poultry Exhibition and on February 18th and 19th there was held at No. 6 Shed Hamilton, one of the most successful poultry exhibitions ever held in the Colony. The Department took an active part in its organisation and members of the Department contributed towards its success with educational and live bird exhibits. A new feature was introduced by the inclusion of displays of commercial booths which occupied the space not required for live bird exhibits. This innovation proved popular, no less than 15 business firms displayed commercial exhibits and their inclusion added much to the interest of the exhibition.

As a result of the interest created by the exhibition and other activities both of the Department and the Poultry Association, poultry raising in the Colony during 1938 received a tremendous stimulus. To what extent this will benefit the poultry industry is a matter for speculation. There is a danger of over enthusiasm, and a tendency to push ahead without regard to the problems at stake. A successful industry capable of producing eggs and poultry-meat planned on a scale to eventually take care of the requirements of the Colony is very desirable, successfully accomplished it would be an asset of considerable importance, and the undertaking deserves careful consideration of the Government. The problems connected with poultry raising within the Colony are many and varied compared with those of other countries, but they undoubtedly can be solved by a properly organised effort.

At the present time we are suffering from lack of definite plans. Commercial firms are pushing the sale of feeds, equipment and stock without regard to their suitability to the industry. Much progress has been made in the field of poultry nutritition in recent years, balanced feeds and good feeding practices are essential to success but these are not effective unless they are backed up by good breeding stock and proper equipment.

According to figures supplied by the Government Veterinary Officer, 27,853 baby chicks were imported into the Colony during 1938. Out of this number less than 500 were from pedigreed stock with a known egg and breeding record.

The poultry field lacks trained workers. There is a definite need for young men who have received practical and scientific training in poultry husbandry. Their training need not be for a college degree but fitted for the management of a commercial plant. A two year's course in an institution leading to a Diploma in Poultry Husbandry followed by one year's working experience on a commercial poultry plant abroad should be productive of good results for this purpose. It is unfortunate that there are no agricultural scholarships available in the Colony to contribute to the advancement of agricultural pursuits which have fallen on evil days.

Trial of the Battery System. Of late years the keeping of laying hens in batteries has assumed considerable prominence in the United States and more recently the system has been given some attention in England. In view of the limited land available in Bermuda for poultry ranging and the consequent danger of ground contamination when chickens are kept in confined runs, the principles of batteries seemed to hold prospects of adaptability to Bermuda conditions. Consequently early in the year the Department purchased a small battery unit consisting of a starting

and growing unit for 100 baby chicks, a developing unit and a laying unit for 60 hens. It is premature yet to report on its suitability for general use in Bermuda because complete records for the first laying year of the hens will not be available until next July. From our experience thus far it seems that the system is well adapted and economical for raising chicks up to ten or twelve weeks of age. The system lends itself to the control of sanitation with a minimum amount of labour which is a very important feature in preventing mortality caused by coccidiosis and other diseases of parasitical origin, in young stock raised by the usual brooding practices. With the commercial starting and growing battery unit used at the Station White Leghorn chicks were raised up to a weight of 1½ lbs. at 8 weeks at a cost of 10d. each for feed, and Rhode Island Red Chicks were raised to a weight of from 2½lbs. to 3½ lbs. at 12 weeks at a cost of 2/6 each for feed.

Many problems remain to be solved before the battery system can be pronounced successful and it may take several years to solve them completely. The primary essential for good results in batteries is to have stock of high vigour and vitality to stand the strain of the intensive conditions of living. The mortality in the laying cages during the late Summer and Fall was 18%. This was higher than might be expected in a well managed plant operated with a yarding system, but it was not unexpected in this case because the building housing the unit is to a great extent unsuitable for the purpose and not conducive to the maximum comfort of the occupants. As might be expected egg production has been variable, some of the pullets which were 10 months old at the end of the year having produced very few eggs, while several other of the same age and breeding have produced over a hundred eggs each and one pullet laid over 150 eggs in the same period.

The results obtained thus far with batteries indicate a fertile field for investigation. The system deserves a thorough trial along with other systems which offer prospects of success. The present experimental unit at the Station is inadequate for the purpose. A more substantial and larger building and more equipment is necessary, which would form a commercial unit and which could be increased to reach the maximum of efficiency within a period of five years. Such a plant would embrace egg and table poultry production and marketing of the products.

MARKETING OF VEGETABLES IN CANADA.

Marketing conditions for vegetables in Canada were poor throughout the shipping season, and the returns on most of the shipments were disappointing.

Business conditions were unfavourable in Canada during 1938. There had been a considerable recession in trade since the previous Fall and there was a pessimistic feeling of uncertainty generally. The fruit and vegetable trade because of the perishable nature of its commodities, reacts quickly to a business recession. Retail sales of vegetables fall off quickly and wholesalers cut prices in an effort to obtain volume of business to offset diminishing profits. Such were the conditions I found on my arrival in Montreal on 10th May and it continued unabated until the end of the shipping season in July. Under conditions such as existed the marketing of Bermuda vegetables becomes a very difficult problem because of the difficulty of keeping them in storage satisfactorily. Because of their perishable nature Bermuda vegetables must of necessity go into consumption quickly to prevent wastage from deterioration. Our competitors in

the market are not so handicapped in this respect because their vegetables are prepared prior to shipment to meet this contingency by being precooled and kept under constant refrigeration to preserve their freshness and prolong their keeping qualities. It is not unusual to see vegetables from our competitors kept under refrigeration in Montreal from one to three months and then placed on the market without repacking and very little loss from deterioration. It is seldom that Bermuda vegetables can be kept in cold storage in Canada for more than two weeks without loss of a high percentage from deterioration. This problem is not new by any means. It has always been recognised as a source of trouble in the Canadian Market. Many efforts have been made to find a cure for the problem without success but the generally accepted remedy, that of precooling followed by constant refrigeration, is yet untried.

The Canadian Market, notwithstanding the advantages granted our competitors by a lowered tariff in recent years, still holds prospects for a profitable outlet for our surplus vegetables if our farmers were helped in the right direction. Fresh vegetables cannot be produced in Canada during our growing season except in a very limited way under glass. Sources of supply in the United States are far removed from the Canadian marketing centres and transportation charges therefrom are in most instances double those in effect between Hamilton and Canadian Seaports. With this advantage and a small margin of preference in tariffs the Bermudian farmer is protected against the higher costs of production locally and should be able to meet competition as far as productive values are concerned. It would therefore seem that the most pressing problem of the farmer is not that of finding a potential market for his crops but to adopt means by conditioning this produce to sell on a competitive basis for quality. Precooling and proper refrigeration are the weapons which our competitors have found effective in this field and the adoption of the same weapons would undoubtedly help the Bermuda farmer to a greater extent than anything else.

Respectfully submitted,

W. R. EVANS,

Agricultural Assistant.

16th January, 1939.

Report of the Horticulturist, 1938.

The Director of Agriculture,

I have the honour to submit my report on horticulture including experimental work undertaken during the year 1938.

WORK IN THE STATION GROUNDS.

Ornamental Grounds. The maintenance of the grounds throughout the year was good, except for adverse weather conditions during the months of January, November and December which tended to lower the standard. Seasonable flowering annuals provided a good display of bloom in the Spring and early Summer. Due to the dry spell of weather prevailing at that time these annuals remained attractive for a considerable period. An attempt was made to keep the beds filled with flowering plants through the Summer but this was not possible. Several alterations in the design of the ornamental grounds were successfully carried out. The major alteration undertaken was to the area in front of the Offices. After removing a large hedge of Hibiscus and loquats, which divided the area into separate pieces, a neat arrangement of beds was designed. New plantings of trees and shrubs have been made where space permitted. In some places badly shaped and diseased cedar trees have been removed to increase the planting area.

Nursery. In the early part of the year more than half of the nursery was replanted. This in future will be annual routine work. By lifting the surplus stock and replanting, a more fibrous rooting system is developed and the resulting plants are much more satisfactory when lifted for sale or distribution. The practice of planting sweet potatoes between nursery stock is not to be recommended as this crop interferes with the development of the young plants and is difficult to lift.

The growth of the annual flower seedlings in the Autumn was very poor. Seeds of many kinds germinated freely, but due to the excessive amount of heavy rain during October and November, there was a great deal of damping-off particularly amongst the very small-seeded kinds. Under these conditions it appears essential to protect many of these annuals in the seedling stage by erecting frames over the seed beds on to which glass lights can be placed during periods of heavy rain.

Orchard. Several young fruit trees chiefly Citrus were planted in the Orchard, but no special attention was given except for periodical hoeing and spraying. Average crops of Loquats and Citrus fruits were gathered. The old beds of Bananas are being broken up and a new plantation established.

Economic Plot. To add further interest to the Agricultural Station a plot has been set aside for the establishment of a collection of economic plants which are not normally grown in Bermuda. The following subjects have been planted, *Coffea arabica, Olea europaea, Gossypium barbadense, Saccharum officinarum, Zingiber officinale, Maranta arundinacea.*

Bermuda Garden. The object of this garden is to have for reference a collection as complete as possible of the true native plants of Bermuda. Several subjects were planted early in the year, but owing to pressure of work in other directions very little progress has been made.

Glass and Slat Houses. Throughout the year glasshouses Nos. 3 and 4 have been used for housing rooted cuttings after potting and for raising seedlings. The other two glasshouses still contain the collections of ferns and orchids. Part of slat house No. 3 has been used for the cultivation of carnations. Most of the palms are now housed in No. 2 slathouse, as this house is more accessible when loaning the palms for social functions. The condition of the plants on the whole has improved, but under the present allocation of labour these houses can only receive a very limited amount of attention, and thus the standard set is rather poor. Many new plants have been raised from seed during the year which are growing quite satisfactorily.

The Public Works Department completely repaired glasshouse No. 4, but the cost of re-roofing slathouses Nos. 3 and 4 was borne by this Department.

EXPERIMENTAL WORK.

Artificial Vegetative Propagation of Amaryllis. Experiments were carried out on the artificial vegetative propagation of Amaryllis to determine whether the methods used in Florida U. S. A. would be applicable in Bermuda, also the most satisfactory season of the year to undertake the work. Bulbs were lifted from April to September and cut vertically into four, eight, sixteen, thirty-two and sixty-four parts. These pieces were inserted in a mixture of marsh peat and sand.

From the results obtained it was clearly shown that Amaryllis can be quickly increased by these methods. By far the most convincing results were obtained from bulbs cut into 16ths about the middle of June. Each section produced one very healthy bulbil which grew quite rapidly. With the bulbs cut in July the results were nearly as good but the plants lacked vigour. Bulbs cut into 8ths and 16ths in April and May were a complete failure.

Perpetual Flowering Carnations. The cultivation of the perpetual flowering carnation has been attempted. Plants taken from 3-inch pots were purchased in April from one of the leading carnation specialists in England. Only varieties used for the commercial production of cut flowers were chosen and they were planted in specially prepared beds in a slat house.

Observations made throughout the first season of growth have revealed some interesting facts. The plants did not respond to the normal methods of cultivation, which obviously means that the climate is not ideal for the cultivation of these carnations. Further investigations will be made to determine the exact cause of the failure of these plants, as the ordinary border carnations are usually very successful in Bermuda.

Gladiolus. For some time it has been realised that Gladiolus grown in Bermuda for one season will bloom very erratically if planted the second time. Attempts have been made to rectify this condition by placing the corms in cold storage for several weeks previous to planting, but as there was no accurate information available for the treatment of Gladiolus in

Bermuda a series of experiments has been carried out with the object of establishing information which will be of value to the florists and other cultivators in the Colony.

The following treatments were given:—

1. Cold Storage at 40°F for 4 weeks before planting.

2. Exposure to ethylene chlorhydrin vapour (8 ccs. to 1 gallon measure of corms) (40 - 50 corms) before planting.

3. Cold Storage at 40°F for 4 weeks and exposure to ethylene chlorhydrin vapour (same strength as above) before planting.

Results of these treatments were as follows:—

No. 1. treatment on varieties, Baron Von Wynbergen, Dr. Von Schubert, Belinde, War, Pfitzers Triumph, Picardy, all produced very healthy plants and flowered very uniformly. In most cases one stem was produced per corm, which commenced blooming 12 weeks after planting.

No. 2 treatment on variety Picardy produced excellent blooms, growth very strong and even. Many of the corms produced two and sometimes three stems and commenced blooming ten weeks after planting.

No. 3 treatment on varieties Pfitzers Triumph and Picardy, growth very strong, and uniform, with two to three stems per corm. Blooming ten to twelve weeks after planting.

From these results it is obvious that the ethylene chlorhydrin treatment has definite advantages over the cold storage treated corms. These experiments are being continued as there is a great deal of variation between one variety and another.

The effect of increased hours of light on Plants. Through the generosity of the Electric Light Company it was possible to study the effect of increased hours of light upon certain plants. The plants used for this work were various annuals, Amaryllis, and Lilium longiflorum varieties. This experiment was carried out over a period of three weeks. During that period there was a marked increase in the growth of some plants, but insufficient to warrant the continuation of the experiment as the consumpton of current was rather high.

Propagation with the aid of Plant Hormones. Several tests have been made with indolylacetic acid and phenylacetic acid, but the results have been very disappointing. Out of thirty kinds of plants treated only *Brunfelsia americana* showed any real response. In this case cuttings treated with indolylacetic acid at a strength of 0.01 gm. in 500 ccs. of water rooted in five weeks, whereas the untreated cuttings under the same conditions took ten weeks to form roots.

Roman Hyacinths. From time to time samples of the Roman Hyacinth bulbs grown in Bermuda have been sent to Messrs. Robert Tucker & Co., London, for information on the behaviour of these bulbs when forced under glass. The reports received on the flowering ability of these bulbs in England has been excellent. With these reports in mind work has been continued on the cultivation of this Hyacinth to increase the production of

saleable bulbs sufficiently to export them to England. The 1938 crop of bulbs fit for exporting was rather poor, only yielding at the rate of 1600 bulbs 11-15 c.m. per acre. This is definitely too low to be of value as a commercial crop. However, at this stage it must be pointed out that these bulbs were grown on poor soil, the only application of fertilizer was in the form of a dressing of equal parts sulphate of ammonia and sulphate of potash applied at the rate of 3 cwts. per acre. From information at hand on the Bermuda soil analysis, it is learnt that in many cases the Bermuda soils are deficient in phosphates. If this is the case the deficiency in phosphates may have some influence on the yield of bulbs. In the 1938-39 growing season the bulbs are being fed more liberally with additional phosphates, with the hope of finding a much more satisfactory yield of bulbs in 1939.

Soil Heating. In collaboration with the Electric Light Company it has been possible to erect frames and install equipment for heating the soil by electricity. These frames wll be largely used for propagating plants by cuttings, but other experiments are under consideration. During the month of December 156 k.w. of current was consumed to maintain the soil in one frame 8 ft. by 6 ft. at an even temperature of 75°F. This is not excessive considering that many plants can be freely propagated by cuttings when bottom heat is available.

Irrigation. With the increasing demand for fresh vegetables during the Summer months it is essential to exploit every possible channel to supply this demand. It was with this in view that an experiment was conducted on irrigation. Work was started on these lines about the middle of July. Although the results obtained did not produce an abundance of material the requirements for successful irrigation were clearly demonstrated. The apparatus used was of the overhead type manufactured by G. W. Skinner & Co., New Jersey, U. S. A.

To operate a 36 ft. pipe line with nozzles at 4 ft. intervals connected to an oscillator, a ¼ h.p. electrically driven pump was used. This motor pumped the water from an underground tank straight into the irrigating plant. The 36 ft. pipe line was sufficient to water a plot of 180 square yards. It was estimated that water was used at the rate of 150 gallons per hour. During continuous dry weather the plot needed three hours watering each day. An assortment of vegetables, strawberries, and flowering plants were planted in the plot, but owing to a shortage of water and bad seed many of these did not mature. A fair crop of French beans and cauliflowers was produced.

Observations made during the experiment show that with a good water supply there are great possibilities in the summer months with properly irrigated land. It is also essential to provide some form of shade to certain vegetables, such as lettuce, turnip etc. and lastly seeds should be imported just previous to sowing.

FRUIT GROWING.

Loquats. During the fruiting season of the loquat (*Eriobotrya japonica*) it was observed that there was a great deal of difference in the fruit from one tree to another. These differences were carefully noted when it was discovered that at least seven varieties were amongst the few trees at the Agricultural Station. This led to further investigation into the number of varieties growing on various properties in other parts of

Bermuda. The perusal of records yielded further information of the variety Advance being imported several years ago, but the whereabouts of these could not be accurately determined. With the seven varieties at the Agricultural Station work was commenced on methods to improve the quality and size of the fruit. In order to have named varieties of the best types at hand, trees of four of the leading market varieties have been imported from California, U. S. A. These will be used for obtaining budding material to bud seedling loquats which have been planted in the nursery. In time it is hoped to be able to raise loquats to distribute and encourage the cultivation of this very valuable fruit. Obviously much more use should be made of the loquat with its ability to fruit so abundantly in this climate.

Other Fruits. Attention has also been given to the cultivation of other fruits such as Papaw, Bananas and Citrus. Seed of the West Indian varieties of Papaw has been imported and young plants are now planted in their fruiting quarters raised from this seed. In the coming year more attention will be given to the work of improving and establishing the production of more fruit in Bermuda.

ADVISORY WORK.

Lectures. The total number of lectures given in Horticultural subjects during the year was seven. These lectures were delivered to Garden Clubs, Arbor Societies and the School Teachers' course on Gardening at the Agricultural Station.

School Gardens. An attempt was made to stimulate interest in School Gardening. During the year four schools were visited and advice given on the planning and planting of the gardens. The schools which have shown their intention of carrying out the scheme are: the Whitney Institute, Port Royal, and the Sandys Grammar School. The Gilbert Institute have a garden already established.

Visits. Throughout the year numerous advisory visits have been made to nurseries, farms, and private gardens. Advice has been given on the control of pests and diseases and other horticultural problems.

OFFICE WORK.

The Office Work included correspondence on Horticultural matters, the writing of Monthly and Special Reports, and contributing articles to the Monthly Agricultural Bulletin. A seed exchange list has been compiled and a list of plants under propagation at the Agricultural Station. Both of these lists are inserted in this report.

PLANT INTRODUCTIONS.

Several new and interesting plants have been introduced to cultivation during the year under review. Amongst the most interesting may be mentioned: *Theobroma cacao, Dipteryx odorata, Salvia pratense, Catalpa speciosa, C. Kampferi, Desmodium gyrans, Acidanthera bicolor var murielae, Brownea Crawfordii, Nepenthes Henryana, N. Hookeriana, N. formosa, Bougainvillea Orange King, Fuchsia varieties, Hevea brasiliensis.* Many others besides these have been raised from seed, but are not yet sufficiently established to mention individually.

NOTEWORTHY PLANTS.

Two exceptionally free flowering trees which deserve greater popularity are *Sabinea carinalis* and *ipomoea Wilcottiana*. The former, a tree about twenty feet high, flowered remarkably well in May. Seeds were produced abundantly which germinated very freely. These seedling trees have been offered to owners of gardens, but very few applications have been received.

PLANT DISTRIBUTION.

The work of distributing plants to public authorities has been continued. Plants were supplied to the Corporation of Hamilton, the Tennis Stadium, Paget Arbor Society, Pembroke Arbor Society, Hamilton Parish Arbor Society, and the Airport. In addition, plants were presented to bazaars, and a large quantity of small trees and shrubs were sold which are not normally stocked by the local nurseries.

Several consignments of seeds were dispatched to Departments of Agriculture and Botanic Gardens overseas.

PERSONAL ACTIVITIES.

In addition to carrying out my normal duties, I assisted in undertaking a part of the responsibilities of the other Officers of the Department while they were on leave of absence.

ACKNOWLEDGMENTS.

Grateful acknowledgment is made of the valuable assistance rendered the Department by contributors of seeds, cuttings, and plants.

Special thanks are due to the Hon. E. A. T. Dutton, Colonial Secretary, Bermuda; The Director, Royal Botanic Gardens, Kew; The Director of Agriculture, Trinidad; and others too numerous to mention individually.

Respectfully submitted,

G. R. GROVES,

Horticulturist.

11th January, 1939.

Report of the Inspector of Produce, 1938.

The Director of Agriculture,

I have the honour to submit my report for the year 1938.

GOVERNMENT PACKING OF VEGETABLES.

No. 1 Packing Shed was opened in the early part of January and remained open until 1st July. Kidney potatoes for the English market, tomatoes, carrots, potatoes and cabbages for the Canadian market, were the chief vegetables packed during the season. No. 2 Packing Shed and the Southampton Packing Shed remained unopened owing to the very poor crop of Cobbler potatoes, tomatoes and onions.

Quantities of vegetables packed. The following table shows the quantities of Government-packed and Farm-packed vegetables:

Quantities of Vegetables Shipped to Canada 1938.

	Government-packed.	Farm-packed.
Beans (crates)	51	—
Beets	191	651
Cabbage	690	643
Carrots	6,474	12,509
Celery	—	9,955
Cucumbers	—	9
Onions	91	195
Potatoes	2,426	1,197
Parsley	—	63
Spinach	—	105
Tomatoes	21,227	835
Miscellaneous	2	6

Quantities of Vegetables shipped to U. S. A. 1938.

	Government-packed.	Farm-packed.
Carrots (crates)	30	—
Kale	—	61
Onions	—	2
Potatoes	30	405
Potatoes (barrels)	—	2,108
Lily buds (boxes)	—	10,368

Quantities of Vegetables shipped to England 1938.

	Government-packed.	Farm-packed.
Potatoes (crates)	1,720	—

Quantities of Vegetables Shipped to West Indies 1938.

	Farm-packed.
Cabbage (crates)	704
Carrots "	177
Onions "	10
Tomatoes "	25
Potatoes "	470
Potatoes (barrels)	13
Potatoes (bags)	62
Miscellaneous (crates)	28

INSPECTION OF FARM-PACKED VEGETABLES.

Mr. C. V. S. Early, Assistant Inspector of Produce, was on duty at the dock during the season, and Mr. T. J. Outerbridge, Sub-Inspector, was on duty when needed.

COMMENTS ON VEGETABLES SHIPPED.

Farm-Packed to New York:

Potatoes. The Triumph and Garnet crops were both good, but very little of either were shipped.

Kale. The small shipment of 61 crates was very good.

Government-packed to Canada:

Potatoes. Triumph potatoes were very good but, owing to the poor market in Canada, the grading and packing of these was very slow and tedious, as only the very best were shipped. Cobbler potatoes showed a great deal of scab and as the Canadian regulations allowed only 5% scab, grading was retarded in order to comply with these regulations.

Tomatoes. Owing to the poor crop and the amount of fruit brought in for packing daily, which was far below average, the cost of packing per crate increased considerably.

Farm-packed to Canada:

Beets and Carrots. Beets were very poor owing to the continued drought, several marks showing fibrous roots. Carrots were generally good throughout the season.

Celery. The entire crop, with the exception of the last two shipments, was in excellent condition, showing no black-heart and only a small portion of blight in the latter part of the season.

Cucumber. This small shipment was fair.

Cabbage. Early cabbage was good. Late cabbage was worm-eaten and packing was poor.

Onions. As this crop was destroyed by blight the shipment was very small and poor.

Parsley. Good but only a small shipment.

Potatoes. Cobblers were very poor, showing large amounts of scab, black-eye, and tuber-moth.

Tomatoes. The Hill Company packed only 799 crates this season owing to the small crop, but they maintained their usual packing standard.

Government-packed to England:

Potatoes. Kidney potatoes were in good condition with exception of a few individual crops which were allowed to remain in the ground after the 70 day period. All these potatoes were graded and packed by hand, consequently taking much longer to pack.

Produce Rejected at the Docks.

Beets	52	crates
Carrots	410	"
Cabbage	67	"
Celery	181	"
Onions	21	"
Potatoes	200	barrels
Potatoes	30	crates

This was practically all picked over and passed inspection for shipment with the exception of three small lots of celery which were condemned out-right.

Supervision of Chill-Rooms.

The chill-rooms were inspected weekly by Assistant Inspector Early, Sub-Inspector Fowle and myself. Amount of breakage was small and stowage good.

SEED POTATOES IMPORTED.

From 1st January to 31st March:

Triumphs from Canada	352	barrels
Garnets " "	17	"
Cobblers " "	260	"
Green Mountain "	10	"

From 1st August to 31st December:

Triumphs from Long Island	2	barrels
" " Canada	2,634	"
Cobblers " "	481	"
" " "	430	bags
Katahdins " "	20	barrels
Garnets " "	1,312	"
Royal Kidney "	194	"

CRATE MATERIAL AND COOPERAGE IMPORTED.

Crate material was inspected on arrival and found to be in good condition. No barrel material or empty barrels were imported this season.

PACKING HOUSE INSPECTION OF LILY BULBS.

Owing to dry weather during growing period the bulbs did not size up to the usual standard. They were bright and of good quality. The shippers all showed great interest and care in selection of the bulbs.

FARMERS' MARKET.

During the year the Market was thoroughly white-washed, painted, and cleaned. All stalls were rented. The opening and closing of the Market by a member of the Department continued throughout the year.

OTHER WORK.

During the year I visited all farmers who grew Kidney potatoes, giving instructions as to time of reaping for shipment to England.

I supervised the stock-taking of crate material, etc., and the laying up and lubrication of all grading machinery. I made several visits to the three Packing Houses during the summer and found them to be in good order.

From 15th August until the end of the year I acted as Foreman in charge of the Cedar Disease Control Gang in Smith's, Devonshire and Pembroke Parishes. (For further details see Report of the Plant Pathologist.)

Respectfully submitted,

T. A. HOLLIS,

Inspector of Produce.

16th January, 1939.

Report of the Government Veterinary Officer, 1938.

The Director of Agriculture,

I have the honour to submit my report for the year 1938.

LOCAL OUTBREAK OF INFECTIOUS DISEASES. An outbreak of Distemper in dogs occurred, chiefly in Pembroke and one case in Tucker's Town — this last in a dog the day after landing from New York. I have therefore advised that dogs landing at St. George's be held until inspected by me.

IMPORTATION OF ANIMALS. The following domestic live stock were imported during the year:

Horses	129	decrease of	240
Dairy Cattle	9	" "	30
Poultry	27,853	increase of	7,110
Dogs	283	decrease of	8
Goats	2	" "	1
Miscellaneous	364	increase of	235

Almost all the dogs imported are brought in by American visitors and are taken back on their return. Day-old chicks were brought by air-service on two occasions.

VISITS OF INSPECTION. During the year I made 233 visits of inspection to quarters of animals on vessels and 326 visits to various parts of the Islands to inspect coolers, inoculate dairy cattle in connection with licences to sell milk and also for the purpose of making tests for contagious abortion in cattle.

TUBERCULIN TEST. Of 1675 cattle subjected to this test 53 reacted. The number tested is 226 less than in 1937 with 11 more reactors. Only 19 cattle were subjected to this test in Somerset, these having been brought in from other parishes; the other cattle were not tested as there has been no tuberculosis there in 7 years.

In this connection I would strongly recommend that the importation of Dairy cattle be stopped at once for a period of two years, as 80% of the reactors to this test are imported cattle. This will not be any hardship to the dairymen as there are plenty of Bermuda-bred cattle to be had. It will also encourage the raising of cattle here.

TESTS FOR CONTAGIOUS ABORTION. From 489 cattle subjected to this test, the following results were obtained in the various parishes.

Parish.	No. tested	Number showing no agglutination.	No. showing agglutination at a titre of 1/25	1/50	1/100	1/150	1/200	1/250	1/500
St. George's	106	80	13	6	3	...	...	1	3
Hamilton	143	113	12	5	2	...	6	...	5
Smith's	209	117	11	14	11	...	16	...	40
Devonshire	24	13	2	1	...	3	...	5	...
Pembroke	6	...	...	...	...	...	...	2	4
Paget	1	1	...	...	...	...	...	...	...

One cow suffering from this disease was slaughtered at the request of the owner.

ACTINOMYCOSIS. One cow in Pembroke infected with this disease was slaughtered.

CONDITION OF DAIRY STOCK. General condition and breed continue to improve.

FARMERS' MARKET. The market was visited weekly with the exception of the two weeks I was on leave. The general conditions continue to be good.

PRIVATE MARKETS. The coolers of the various markets were inspected frequently and the conditions found to be improved and all working satisfactorily.

CRUELTY TO ANIMALS. Professional evidence was given in 8 cases prosecuted by the Police—an increase of 5 cases as compared with 1937.

RECORD OF MOVEMENTS. I was absent on leave from 3rd to 17th July, when I went to New York City to attend the American Veterinary Association's Diamond Jubilee Convention.

I am very glad to report that some of our energetic Poultry Fanciers have re-organised the Bermuda Poultry Association. An exhibition held on the 18th and 19th February was specially good as regards exhibits of the various breeds and was well patronised. The poultry industry has benefited by their efforts. Another exhibition has been planned for February 1939.

Respectfully submitted,

C. J. COOPER,

Government Veterinary Officer.

17th January, 1939.

Appendix A.

RAINFALL RECORDED AT AGRICULTURAL STATION, 1938.

January	5.84 inches
February	2.25 "
March	1.51 "
April	2.76 "
May	8.98 "
June	2.79 "
July	3.29 "
August	2.60 "
September	4.51 "
October	11.95 "
November	5.79 "
December	7.61 "
	59.88 inches

RAINFALL FOR LAST FIVE YEARS.

1933	46.22 inches
1934	56.67 "
1935	64.85 "
1936	55.24 "
1937	62.16 "

C. V. S. EARLY,
Station Foreman.

6th January, 1939.

Appendix B.

FINANCIAL STATEMENTS.

(a) Expenditure (Exclusive of Personal Emoluments) for the Year ended 31st December, 1938.

General Grant.

Appropriated by Act No. 49 of 1937					£1,500	0 0
Labour for experimental plots, lawns, flower-beds, roads, livestock etc.	£1,183	14	8			
Seed, manure and fertilisers	25	9	3			
Livestock feed, bedding and incidentals	164	6	11			
Repairs and renewals of buildings, tools etc.	50	5	8			
Printing	52	10	0			
Contingencies	23	12	4			
Unexpended Balance		1	2			
	£1,500	0	0		£1,500	0 0

Inspection Services, Market Investigations and Contingencies.

Appropriated by Act No. 49 of 1937					£ 800	0 0
Inspection of vegetables at dock and at Packing Houses	£	38	18	0		
Representation, Canada and United Kingdom		197	3	7		
Advertising in Canada		11	17	1		
Purchase & Advertising of lily bulbs		71	16	3		
Freight on experimental shipments to Canada and England		184	2	10		
Printing in connection with shipping of vegetables		19	11	0		
Purchase of crates & machinery		148	8	3		
Cables		30	6	5		
Contingencies		5	14	10		
Unexpended Balance		92	1	9		
	£	800	0	0	£ 800	0 0

Control of Animal Diseases.

Appropriated by Act No. 49 of 1937					£ 450	0 0
Appropriated by Supplementary Resolve No. 2 of 1939					100	0 0
Compensation to owners of condemned cattle	£	524	4	0		
Payment to Livestock Committee		14	8	0		
Supplies and contingencies		8	4	1		
Unexpended Balance		3	3	11		
	£	550	0	0	£ 550	0 0

Control of Plant Diseases and Pests.

Appropriated by Act No. 49 of 1937					£ 200	0 0
Labour	£	90	6	2		
Fungicides, insecticides, oil etc.		43	11	4		
Repairs to Laboratory and purchase of equipment		23	4	1		
Repairs to Spray Machines		7	1	0		
Printing		8	16	3		
Subscriptions to periodicals		4	8	9		
Investigations re Japanese Beetle		20	0	0		
Unexpended Balance		2	12	5		
	£	200	0	0	£ 200	0 0

Improvement of Livestock.

Appropriated by Act No. 49 of 1937					£ 150	0 0
Purchase of Livestock	£	113	10	11		
Lighting and heating Battery		14	16	6		
Supplies and Contingencies		19	13	6		
Unexpended Balance		1	19	1		
	£	150	0	0	£ 150	0 0

Horticulture.

Appropriated by Act No. 49 of 1937					£ 150	0 0
Labour	£	26	19	0		
Repairs and renewals of glass-houses, tools etc.		51	9	11		
Cost of Soil heating frames		11	13	11		
Seeds, bulbs and plants		52	3	3		
Contingencies		7	12	2		
Unexpended Balance			1	9		
	£	150	0	0	£ 150	0 0

Departmental Contingencies.

Appropriated by Act No. 49 of 1937					£ 120	0 0
Local travelling expenses, bicycle allowances, postage etc.	£	14	18	10		
Stationery and other office supplies		55	3	10		
Printing		16	1	8		
Lighting, Power and Telephones		29	18	8		
Subscriptions to periodicals			14	1		
Unexpended Balance		3	2	11		
	£	120	0	0	£ 120	0 0

Packing House, Services and Contingencies.

Appropriated by Act No. 49 of 1937								£3,500	0 0
Packing House Supplies:									
Nails £20	11	0							
Boxes etc. 31	6	11	£	51	17	11			
Labour: Pasting labels, making crates, grading, packing, cartage etc				1,228	15	9			
Electric Current, light and power, Telephones				14	6	11			
Rental Southampton Packing Site				12	0	0			
Repairs to buildings and machinery				27	2	6			
Cold Storage of vegetables				141	1	9			
Insurance of Packing Houses				33	12	0			
Printing and stationery				22	9	6			
Unexpended Balance				1,968	13	8			
				£3,500	0	0		£3,500	0 0

Control of Cedar Diseases.

Appropriated by Resolve No. 11 of 1938								£1,000	0 0
Labour			£	899	17	6			
Spray Material				30	5	0			
Purchase of tools, paint and sharpening of saws				59	5	4			
Travelling expenses, cartage etc.				10	11	4			
Unexpended Balance						10			
				£1,000	0	0		£1,000	0 0

(b) REIMBURSEMENTS TO GOVERNMENT.

Sale of vegetables								£ 58	10 8
plants								47	8 10
spraying material								31	4 2
eggs and chickens								23	8 1
livestock								22	10 0
crates								19	17 0
Seedmen's Licences								1	15 0
Imprest Account: J. M. Waterston								2	8 10
Livestock and Veterinary fees								8	11 0
Packing House Receipts: charges for packing								983	7 4
								£1,199	0 11

(c) FARMERS' MARKET.

Balance brought forward					£	90	3 10
Received for hire of stalls						158	0 0
Rental of Market	£	100	0	0			
Lighting		9	16	6			
Repairs, cleaning and closing of Market		35	0	6			
Unexpended balance carried over		103	6	10			
	£	248	3	10	£	248	3 10

Appendix C.

DISPOSAL OF PRODUCE, 1938.

Milk and Vegetables to King Edward VII Memorial Hospital, valued at	£57 0 0
Vegetables and Plants donated to Bazaars, valued at	3 0 0
Plants donated to Arbor Societies, etc. valued at	30 10 0
	£90 10 0

Appendix D.

LICENSED VETERINARIANS.

The following are authorised to practise veterinary science under provisions of The Agriculture Act 1930.

R. L. Tucker, D.V.S.
C. J. Cooper, V.S.
J. W. Sutherland, B.V.Sc.

LICENSED SHIPPERS OF PRODUCE.

The following persons or firms are licensed to ship produce under provisions of The Agriculture Act 1930.

A. C. Benevides
J. M. Darrell
Henry Dunkley & Co.
The Hill Co.
O. R. Loblein Ltd.
Pearman, Watlington & Co.
Manuel F. Simons (Kale to United States of America).

LICENSED FARMER-SHIPPERS.

The following persons are licensed under provisions of The Agriculture Act, 1930 to ship produce grown by themselves.

Malcolm Hollis
Gabriel Jacome
M. F. King & Son
M. S. Madeiros
E. J. Moniz
J. De Moura
Bento Oliviera & Son
Louis Perreira
E. W. Outerbridge
J. R. Outerbridge
D. C. Robinson
P. B. Stephens
J. Da Costa Da Silva
L. B. Hollis

LICENSED LILY SHIPPERS.

The following persons or firms are licensed to ship lily bulbs under provisions of The Agriculture Act 1930.

T. O. Covel
Henry & Lee
Malcolm Hollis
W. G. Hollis
E. W. Outerbridge Co.
J. R. Outerbridge
H. E. D. Smith
M. J. King

LICENSED SEEDMEN.

The following persons or firms are licensed to sell Vegetable Seed under provisions of The Agriculture Act, 1930, and Byelaws for the Sale of Vegetable Seed.

Henry Dunkley & Co.
J. R. Outerbridge
O. R. Loblein Ltd.
Curtis & Barnard
The Hill Co.
Hodgson Stores
T. J. Wadson & Son

Appendix E.

At the request of the Hon. E. A. T. Dutton, Colonial Secretary, Bermuda, a List of Plants under Propagation at the Agricultural Station and a List of Seeds for Exchange are printed with this Report.

LIST OF PLANTS UNDER PROPAGATION AT THE AGRICULTURAL STATION, DECEMBER 1938.

Abelia R. Br. **Caprifoliaceae.**
A. grandiflora Rehd.

Aberia Hochst. **Bixaceae.**
A. caffra Hook. F. Haw.

Acalypha L. **Euphorbiaceae.**
A. Godseffiana Mast.
A. Hamiltoniana Hort.
A. hispida Burm. f.
A. macrostachya Jacq.
A. Wilkesiana Muell.

Achras L. **Sapotaceae.**
A. Sapota L.

Adenanthera L. **Leguminosae.**
A. pavonina L.

Ailanthus Desf. **Simarubaceae.**
A. grandis Prain.

Albizzia Durass. **Leguminosae.**
A. Lebbek Benth.

Allamanda L. **Apocynaceae.**
A. cathartica L.
var. Schottii L. H. Bailey & Raffill.

Annona L. **Annonaceae.**
A. Cherimola Mill.
A. muricata L.
A. squamosa L.

Antigonon Endl. **Polygonaceae.**
A. leptopus. Hook & Am.

Ardisia Sw. **Myrsinaceae.**
A. escallonioides Cham. & Schlecht.

Barleria L. **Acanthaceae.**
B. cristata L.

Bauhinia L. **Leguminosae.**
B. acuminata L.
B. alba
B. Galpini N. E. Br.
B. purpurea L.

Beaumontia Wall. **Apocynaceae.**
B. grandiflora Wall.

Beloperone Nees. **Acanthaceae.**
B. guttata Brandegee

Bixa L. **Bixaceae.**
B. Orellana L.

Bombax L. **Malvaceae.**
B. ellipticum H.B.K.

Bougainvillea Comm. **Nyctaginaceae.**
B. glabra Choisy

Brunfelsia L. **Solanaceae.**
B. americana L.

Buddleia L. **Loganiaceae.**
B. madagascariensis Lam.

Caesalpinia L. **Leguminosae.**
C. pulcherrima Sw.

Cajanus D. C. **Leguminosae.**
C. indicus Spreng.

Carica L. **Passifloraceae.**
C. Papaya L.

Carissa L. **Apocynaceae.**
C. grandiflora A. DC.

Cassia L. **Leguminosae.**
C. Fistula L.
C. floribunda Hort.
C. grandis L.
C. nodosa
C. spectabilis

Casuarina L. **Casuarinaceae.**
C. Cunninghamiana Miq.
C. equisetifolia L.

Catalpa Scop. **Bignoniaceae.**
C. longissima Sims.
S. speciosa Warder.

Catha Forsk. **Celastraceae.**
C. edulis Forsk.

Clerodendron L. **Verbenaceae.**
C. fallax Lindl.
C. splendens G. Don.

Clitoria L. **Leguminosae.**
C. Ternatea L.

Clytostoma Miers ex. Bar. **Bignoniaceae.**
C. callistegioides

Codiaeum Rumph. **Euphorbiaceae.**
C. variegatum Blume.
numerous garden varieties.

Coffea L. **Rubiaceae.**
C. arabica L.

Cordia L. **Boraginaceae.**
C. Sebestena L.

Couroupita Aubl. **Myrtaceae.**
C. guianensis Aubl.

Crossandra Salisb. **Acanthaceae.**
C. undulaefolia Salisb.

Daedalacanthus T. Anders **Acanthaceae.**
D. nervosus T. Anders

Desmodium Desv. **Leguminosae.**
D. Gyrans DC.

Dombeya Cav. **Sterculiaceae.**
D. spectabilis Bojer

Duranta L. **Verbenaceae.**
D. Plumieri Jacq.

Elaeodendron Jacq. f. **Celastraceae.**
E. Laneanum A. H. Moore.

Eranthemum L. **Acanthaceae.**
E. atropurpureum Hort.

Eriobotrya Lindl. **Rosaceae.**
E. japonica Lindl.

Erythrina L. **Leguminosae.**
E. Corallodendron L.

Ficus L. **Urticaceae.**
F. elastica Roxb.
F. nitida Blume
F. pumila L.
var. minima Hort.

Galphimia Cav. **Malpighiaceae.**
G. brasiliensis A. Juss

Graptophyllum Nees. **Acanthaceae.**
G. hortense Nees.

Grevillea R. Br. **Proteaceae.**
G. robusta A. Cumm.

Guaiacum L. **Zygophyllaceae.**
G. officinale L.

Haematoxylon L. **Leguminosae.**
H. campechianum L.

Hamelia Jacq. **Rubiaceae.**
H. patens Jacq.

Hibiscus L. **Malvaceae.**
H. mutabilis L.
H. rosa-sinensis vars.
H. schizopetalus Hook. f.
H. tiliaceus L.

Holmskioldia Retz. **Verbenaceae.**
H. sanguinea Retz.

Ixora L. **Rubiaceae.**
I. coccinea L.

Jacaranda Juss. **Bignoniaceae.**
J. ovalifolia R. Br.

Jacobinia Moric **Acanthaceae.**
J. aurea (Schlecht) Hemsl.

Lagerstroemia L. **Lythraceae.**
L. indica L.

Malpighia L. **Malpighiaceae.**
M. coccigera L.

Malvaviscus Adams. **Malvaceae.**
M. grandiflorus H. B. K.
M. mollis Dc.

Manihot Mill **Euphorbiaceae.**
M. utilissima Pohl.

Melia L. **Meliaceae.**
M. Azedarach L.

Mimosa L. **Leguminosae.**
M. pudica L.

Murraya Koenig. **Rutaceae.**
M. exotica L.

Nerium L. **Apocynaceae.**
N. Oleander L.
various garden forms.

Odontonema Nees. **Acanthaceae.**
O. strictum Kuntze.

Olea L. **Oleaceae.**
O. europaea L.

Parmentiera DC. **Bignoniaceae.**
P. cerifera Seem.

Pentas Benth. **Rubiaceae.**
P. lanceolata Schum.

Peristrophe Nees. **Acanthaceae.**
P. speciosa Nees.

Phyllanthus L. **Euphorbiaceae.**
P. nivosus Hort.

Pittosporum Banks. **Pittosporaceae.**
P. Tobira Ait.
var. variegatum Hort.
P. undulatum vent.

Plumbago L. **Plumbaginaceae.**
P. capensis Thunb.

Plumeria L. **Apocynaceae.**
P. rubra L.

Poinciana L. **Leguminosae.**
P. regia Boj.

Polyscias Forst. **Araliaceae.**
P. Balfouriana L. H. Bailey
P. dissecta Bull
P. Guilfoylei L. H. Bailey

Psidium L. **Myrtaceae.**
P. Guajava L.

Punica L. **Lythraceae.**
P. Granatum L.

Rivina L. **Phytolaccaceae.**
R. aurantiaca Warsy.

Ruellia L. **Acanthaceae.**
R. amoena Nees.
R. macrophylla Vahl.

Sabinea **Leguminosae.**
S. carinalis

Salvia L. **Labiatae**
S. farinacea Benth.
S. Grahami Benth.
S. splendens Kev-Gawl.

Sanchezia Ruia & Pav. **Acanthaceae.**
S. nobilis Hook. F.

Schinus L. **Anacardiaceae.**
S. terebinthifolius Raddi.

Solandra Sw. **Solanaceae.**
S. grandiflora SW.

Sophora L. **Leguminosae.**
S. tetroptera Mill.

Swietenia Jacq. **Meliaceae.**
S. Mahagoni Jacq.

Theobroma L. **Sterculiaceae.**
T. Cacao L.

Thunbergia Retz. **Acanthaceae.**
T. erecta T. Anders.
var. alba

Turnera L. **Turneraceae.**
T. ulmifolia L.

Viburnum L. **Caprifoliaceae.**
V. odoratissimum Kev.-Gawl.

LIST OF SEEDS FOR EXCHANGE.

The following is a list of seeds and bulbs for exchange with Botanic Gardens and with other regular correspondents of the Department.

As it is not practicable to hold a stock of seeds in Bermuda, a list of the requirements of correspondents is kept, and seeds are despatched as soon as they become available.

Applications for seeds and bulbs should be made to

The Horticulturist,
Department of Agriculture,
Paget East,
Bermuda.

Aberia Hochst. **Bixaceae.**
A. caffra Hook. F. Haw

Acrostichum L. **Polypodiaceae.**
A. excelsum Maxon.

Adenanthera L. **Leguminosae.**
A. pavonina L.

Adiantum (Tourn) L. **Polypodiaceae.**
A. bellum T. Moore

Albizzia Durass. **Leguminosae.**
A. Lebbek Benth.

Anchistea Presl. **Polypodiaceae.**
A. virginica (L) Presl.

Annona L. **Annonaceae.**
A. Cherimola Mill.
A. muricata L.
A. squamosa L.

Anopteris (Pranth) Diels **Polypodiaceae.**
A. hexagona (L.) Christensen

Araucaria Juss. **Pinaceae.**
A. excelsa R. Br.

Archontophoenix Wendle & Drude **Palmaceae.**
A. Cunninghamiana Wendle & Drude

Ardisia SW. **Myrsinaceae.**
A. crenata Roxb.

Asclepias L. **Asclepiadaceae.**
A. curassavica L.

Ascyrum L. **Hypericaceae.**
A. macrosepalum S. Brown

Asparagus L. **Liliaceae.**
A. plumosus Baker
A. Sprengeri Regal.

Asplenium L. **Polypodiaceae.**
A. dentatum L.
A. heterochroum Kunze.

Babiana Ker **Iridaceae.**
B. stricta Ker.

Beloperone Nees. **Acanthaceae.**
B. guttata Brandegee

Borrichia Adans. **Compositae.**
B. arborescens (L.) DC.
B. frutescens (L.) DC.

Brunfelsia L. **Solanaceae.**
B. americana L.

Bryophyllum Salisb. **Crassulaceae.**
B. pinnatum (Lan.) Kurz.

Caesalpinia L. **Leguminosae.**
C. pulcherrima SW.

Cajanus D. G. **Leguminosae.**
C. indicus Spreng.

Callistemon R. Br. **Myrtaceae.**
C. lanceolatus DC.

Calophyllum L. **Guttiferae.**
C. Calaba Jacq.

Carica L. **Passifloraceae.**
C. Papaya L.

Carissa L. **Apocynaceae.**
C. grandiflora A. DC.

Cassia L. **Leguminosae.**
C. bicapsularis L.
C. ligustrina L.
C. occidentalis L.

Casuarina L. **Casuarinaceae.**
C. Cunninghamiana Miq.
C. equisetifolia L.

Catalpa Scop. **Bignoniaceae.**
C. longissima Sims.

Celtis (Tourn.) L. **Ulmaceae.**
C. mississippiensis Bosc.

Cestrum L. **Solanaceae.**
C. Parqui L. Her.

Chiococca L. **Rubiaceae.**
C. bermudiana S. Brown.

Citharexylum L. **Verbenaceae.**
C. quadrangulare Jacq.

Clerodendron L. **Verbenaceae.**
C. fallax Lindl.

Cocos L. **Palmaceae.**
C. plumosa Hook.

Coccolobis P. Br. **Polygonaceae.**
C. uvifera (L.) Jacq.

Conocarpus L. **Combretaceae.**
C. erecta L.

Cordia L. **Boraginaceae.**
C. Sebestena L.

Crescentia L. **Bignoniaceae.**
C. Cujete L.

Crossandra Salisb. **Acanthaceae.**
C. undulaefolia Salisb.

Croton L. **Euphorbiaceae.**
C. punctatus Jacq.

Cryptostegia R. Br. **Asclepiadaceae.**
C. grandiflora R. Br.

Cycas L. **Cycadaceae.**
C. revoluta Thunb.

Daedalacanthus T. Anders **Acanthaceae.**
D. nervosus T. Anders

Dictyosperma Wendl. **Palmaceae.**
D. alba Wendl.

Dodonaea (L.) Jacq. **Dodonaceae.**
D. jamaicensis DC.

Doryanthes Correa **Amaryllidaceae.**
D. Palmeri W. Hill

Dracaena Vand. **Liliaceae.**
D. terminalis L.

Dryopteris Adans. **Polypodiaceae.**
D. bermudiana (Baker) Gilbert
D. normalis Christensen
D. speluncae (L.) Underwood
D. Thelypteris (L.) Gray.

Duranta L. **Verbenaceae.**
D. plumieri Jacq.

Elaeodendron Jacq. F. **Celastraceae.**
E. Laneanum A. H. Moore

Erigeron L. **Compositae.**
E. Darrellianus Hemsley

Eriobotrya Lindl. **Rosaceae.**
E. japonica Lindl.

Erythrina L. **Leguminosae.**
E. Corallodendron L.

Eugenia L. **Myrtaceae.**
E. uniflora L.

Euphorbia L. **Euphorbiaceae.**
E. heterophylla L.
E. pulcherrima Willd.

Forestiera Poiret. **Oleaceae.**
F. segregata (Jacq.) Krug & Urban.

Freesia Klatt. **Iridaceae.**
F. refracta vars.

Glycosmis Correa **Rutaceae.**
G. pentaphylla Corr.

Gossypium L. **Malvaceae.**
G. barbadense L.

Guaiacum L. **Zygophyllaceae.**
G. officinale L.

Haematoxylon L. **Leguminosae.**
H. campechianum L.

Hamelia Jacq. **Rubiaceae.**
H. patens Jacq.

Heliotropium L. **Boraginaceae.**
H. peruvianum L.

Hibiscus L. **Malvaceae.**
H. mutabilis L.
H. tiliaceus L.

Hippeastrum Herb. **Amaryllidaceae.**
H. vittatum vars.

Hymenocallis Salisb. **Amaryllidaceae.**
H. declinata (Jacq.) Roein

Hyophorbe Gaertn. **Palmaceae.**
H. verschaffeltii H. Wendl.

Ilex L. **Aquifoliaceae.**
I. cassine Small & Verrill

Indigofera L. **Leguminosae.**
I. suffruticosa Mill.

Ipomoea L. **Convolvulaceae.**
I. biloba Forstk.
I. setosa Ker.
I. sidaefolia Choisy.

Jasminum L. **Oleaceae.**
J. simplicifolium Forstk.

Jatropha L. **Euphorbiaceae.**
J. multifida L.
J. podagrica Hook.

Juniperus Tourn exL. **Pinaceae.**
J. bermudiana L.

Kigelia DG. **Bignoniaceae.**
K. pinnata (Jacq.) DC.

Lagerstroemia L. **Lythraceae.**
L. indica L.

Lantana L. **Verbenaceae.**
L. aculeata L.

Lapeyrousia Pourr. **Iridaceae.**
L. cruenta Baker

Leucaena Benth. **Leguminosae.**
L. glauca L.

Lilium Tourn. ex L. **Liliaceae.**
L. longiflorum vars.

Livistona R. Br. **Palmaceae.**
L. chinensis R. Br.

Lonchocarpus N. B. et K. **Leguminosae.**
L. violaceus H. B. K.

Maurandia Orteg. **Scrophulariaceae.**
M. scandens (Cav.) Pers.

Melia L. **Meliaceae.**
M. Azedarach L.

Mimosa L. **Leguminosae.**
M. pudica L.

Mirabilis Riv. exl. **Nyctaginaceae.**
M. Jalapa L.

Myrica L. **Myricaceae.**
M. cerifera L.

Nerium L. **Apocynaceae.**
N. Oleander L.

Odontonema Nees. **Acanthaceae.**
O. strictum Kuntze

Opuntia Mill. **Cactaceae.**
O. Dillenii (Ker.) Haw.

Oreodoxa Willd. **Palmaceae.**
O. regia H. B. K.

Osmunda L. **Polypodiaceae.**
O. cinnamomea L.
O. regalis L.

Pandanus L. **Pandanaceae.**
P. utilis Bory.

Peperomia Pav. **Piperaceae.**
P. septentrionalis Brown.

Peristrophe Nees **Acanthaceae.**
P. speciosa Nees.

Phoenix L. **Palmaceae.**
P. canariensis Hort.

Pimenta Lindl. **Myrtaceae.**
P. officinalis Lindl.

Pittosporum Banks. **Pittosporaceae.**
P. timorense Ait.
P. Tobira Ait.
P. undulatum Vert.

Poinciana L. **Leguminosae.**
P. regia Boj.

Polypodium L. **Polypodiaceae.**
P. plumula H. B. K.

Polystichum Roth. **Polypodiaceae.**
P. adiantiforme (Foster) J. Smith

Psidium L. **Myrtaceae.**
P. Guajava L.

Psychotria L. **Rubiaceae.**
P. ligustrifolia Millsp.

Pteris L. **Polypodiaceae.**
P. caudata L.
P. longifolia L.

Punica L. **Lythraceae.**
P. Granatum L.

Randia L. **Rubiaceae.**
R. aculeata L.

Rhizophora L. **Rhizophoraceae.**
R. Mangle L.

Ricinus (Tourm) L. **Euphorbiaceae.**
R. communis L.

Rivina L. **Phytolaccaceae.**
R. aurantiaca Warsz.

Ruellia L. **Acanthaceae.**
R. amoena Nees.
R. macrophylla Vahl.

Russelia Jacq. **Scrophulariaceae.**
R. equisetifolia Schl. & Cham.

Sabal Adans. **Palmaceae.**
S. Blackburnianum Glazebk.

Sabinea **Leguminosae.**
S. carinalis

Salvia L. **Labiatae.**
S. coccinea L.
S. serotina L.
S. splendens Kev.-Gawll.

Sisyrinchium L. **Iridaceae.**
S. bermudianum L.

Solanum L. **Solanaceae.**
S. aculeatissimum Jacq.
S. seaforthianum Andr.
S. Wendlandii Hook. f.

Sprekelia Heirt. **Amaryllidaceae.**
S. formosissima Herb.

Stephanotis Thon. **Asclepiadaceae.**
S. floribunda Brongn.

Suriana L. **Surianaceae.**
S. maritima L.

Tabebuia Gomez. **Bignoniaceae.**
T. pallida Miers.

Tamarindus L. **Leguminosae.**
T. indica L.

Tecoma Juss. **Bignoniaceae.**
T. stans (L.) Juss.

Tecomaria Spack. **Bignoniaceae.**
T. capensis (Thunb.) Spack.

Thunbergia Retz. **Acanthaceae.**
T. alata vars.
T. erecta T. Anders

Turnera L. **Turneraceae.**
T. ulmifolia L.

Verbena Linn. **Verbenaceae.**
V. bonariensis L.

Vigna Savi **Leguminosae.**
V. repens (L.) Kuntze.

Vinca L. **Apocynaceae.**
V. rosea L.

Yucca Dill ex L. **Liliaceae.**
Y. aloifolia L.

Zanthoxylum L. **Rutaceae.**
Z. flavum Vahl.

Zingiber Adans. **Zingiberaceae.**
Z. officinale Roscoe.